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Proceedings of the First EPA/Industry Forum
Held at Denver Stauffer Inn, Denver, Colorado on
January 23-24, 1979

CK GeoEnergy Corp.
Las Vegas, NV

Prepared for

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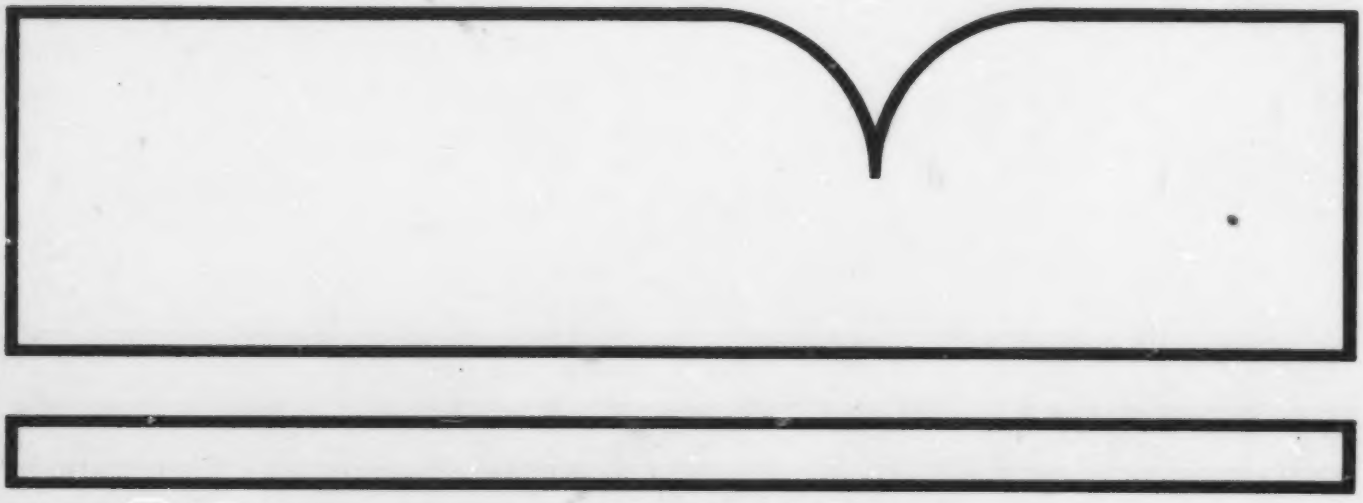

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16. ABSTRACT

This publication reports the proceedings of the first meeting of the joint EPA/ Industry Forum to Research Technical and Regulatory Problems relating to Oil Shale. The purpose of the meeting was to establish a closer working relationship between EPA and industry and to develop better channels of communication.

Attending the meeting were federal representatives from EPA and DOE, state representatives from Colorado and personnel from all of the companies active in oil shale development and research programs. Highlights of the meeting included presentations by the EPA Region VIII Administrator, the DOE Deputy-Undersecretary for Commercialization, and reviews of eleven (11) active oil shale development projects by representatives of the operating companies. The meeting took place in Denver, January 23-24, 1979.

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Oil Shale

Proceedings of the EPA/Industry Forum January 23-24, 1979

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EPA PROGRAM CONFERENCE REPORT:

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FOREWORD

Within EPA's Office of Research and Development (ORD) is the Office of Energy, Minerals and Industry (OEMI). This office was created in response to the need for priority development of coal and alternative energy sources as a result of the Arab oil embargo of 1973-1974. The Industrial Environmental Research Laboratory (IERL) within OEMI at Cincinnati, Ohio, has the responsibility for implementing OEMI's energy program pertaining to oil shale. The major goal of this research facilities' program is the assessment and development of control technology in accordance with the mandates laid down by the Clean Air Act (CAA), the Clean Water Act (CWA), the Resource Conservation and Recovery Act (RCRA) and the Toxic Substances Control Act (TSCA). Whereas the objective of this program is to service the research needs of the regulatory offices of EPA, the program must also be responsive, in a time frame not to impede commercialization, to the Department of Energy's (DOE) need to develop the emerging energy technologies in an environmentally acceptable manner. OEMI supports the EPA regulatory offices by providing research data and criteria information for the standard setting function. OEMI supports DOE and the other federal agencies engaged in energy-related research and development through funding of cooperative efforts, and by assessing and providing expertise for the development and implementation of the best available control technology (BACT).

The EPA/Industry Forum meeting that is covered in this report is one of two that have been planned for this year. The objective of these meetings is to bring together, in forum style, the developers of oil shale retorting processes and the large owners of shale oil properties with the research and regulatory personnel in EPA:

- for discussion of the environmental concerns that are limiting faster development,
- for exploration of cooperative research efforts that could mitigate these concerns, and
- for effecting other activities that would foster clear and worthwhile communications between government and industry.

It has been my impression that the forum is succeeding in the above goals.

Steven R. Reznek
Deputy Assistant Administrator
Energy, Minerals, and Industry

PREFACE

The U.S. Environmental Protection Agency is involved in oil shale research and development through projects for which it provides funds, and stays abreast of projects funded by other governmental and industrial sources. Research provides data for defining ecological and health effects and for developing cost-effective control technology that can be used by government and industry to minimize degradation of the environment.

This report presents the proceedings of the first EPA/Industry Oil Shale Forum.

This report is submitted in partial fulfillment of Contract Number 68-01-5029 by C.K. GeoEnergy Corporation under the sponsorship of the U.S. Environmental Protection Agency's Office of Energy, Minerals and Industry, Headquarters, and its Industrial Environmental Research Laboratory, Cincinnati, Ohio.

Funding for the publication of this report was accomplished under EPA Grant R-806156 with the Denver Research Institute.

ABSTRACT

The first meeting of the joint EPA/Industry Forum, which addressed research, technical and regulatory problems relating to oil shale, was held in Denver, January 23-24, 1979. Attending were federal representatives from the EPA and DOE, state representatives from Colorado, and personnel from all of the companies active in oil shale development and research programs. The main purpose of the meeting was to establish a closer working relationship between the EPA and industry and to develop better channels of communications.

Alan Merson, regional administrator of the EPA, and DOE's deputy undersecretary for commercialization, Jackson Gouraud, outlined the government's plans and schedules for oil shale development. Both stressed the need for an oil shale industry, while insisting that a few commercial-sized modules should be built initially to provide real data on potential environmental problems from large-scale developments. These presentations elicited a number of questions from industry representatives. These questions were frankly and succinctly answered.

Informative presentations also were made by the chief of the Oil Shale Environmental Assessment Program, Alden Christianson, and the EPA's Region VIII deputy director of the Office of Energy, Terry Thoem, who reviewed the research program and discussed the current and proposed regulations relating to oil shale.

On the industry side, an excellent overview of the progress of oil shale development was presented at the First EPA/Industry Forum by representatives of those companies actively working in this area: Colony Development [Les Ludlam], Equity Oil [Paul M. Dougan], Geokinetics [Steve Mankowski], Multi Mineral Corporation [Ben Weichman], Occidental (C-b) [W. F. McDermott], Rio Blanco (C-a) [J. B. Miller], Sohio [Harry Pforzheimer], Superior Oil [John H. Knight], TOSCO [H. Michael Spence], White River [Rees Madsen], and Union Oil [Ron Bissinger]. Discussions described the current status of each of the projects and projected future activities.

Penetrating questions and discussions characterized the interchange between industry and government personnel throughout the two-day meeting. From the response of both government and industry representatives, it was clear that the meeting was successful. Such open exchanges of information and opinion should point the way to cooperation between the EPA and industry in bringing oil shale into production in a manner that is both feasible and environmentally satisfactory.

ACKNOWLEDGMENTS

The Environmental Protection Agency wishes to acknowledge its gratitude and appreciation to the managements of the oil shale companies or ventures for their participation at the first meeting of the EPA/industry oil shale forum. The management of EPA's oil shale program recognizes that the forum concept would not be successful without the full and enthusiastic participation of the overall industry.

The authors wish to thank Paul Westcott of the Denver Research Institute for supervision of the editing and camera copy preparation, and Paul E. Mills, IERL-Ci, who provided the financial and administrative support to the Denver Research Institute. The Denver Research Institute Word Processing Center also deserves thanks for its invaluable help in revising and producing the camera copy.

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INTRODUCTION/ EXECUTIVE OVERVIEW

FIRST MEETING OF JOINT EPA/INDUSTRY OIL SHALE WORKING GROUP

Denver Stouffer Inn
Denver, Colorado
January 23-24, 1979

Seventy-five representatives of industry, the Environmental Protection Agency, the Department of Energy, and the Colorado state government participated in the first EPA/ Industry oil shale forum. Highlights of the meeting included presentations by the EPA Region VIII administrator, Alan Merson, and the DOE deputy undersecretary for commercialization, Jackson Gouraud, and reviews of eleven active oil shale development projects by representatives of the operating companies.

A brief summation of each speaker's remarks follows.

EPA-REGION VIII, ALAN MERSON, REGIONAL ADMINISTRATOR

Merson summarized the types of environmental questions that need answering before a large oil shale industry can be developed. These include: groundwater quality and contamination, disposal and revegetation of spent shale, NO_x and SO_2 contamination, air quality, trace element concentrations, applicability of pollution control and technology, and the population growth associated with oil shale development.

Merson believes that answers to most of these questions can be found by a rigorous testing program built around prototype commercial-scale facilities. Facilities capable of producing about 150,000 BOPD would be adequate to determine the environmental impact of an oil shale industry. He strongly advocates working jointly with industry and DOE in order to achieve commercialization in an environmentally acceptable manner.

EPA-WASHINGTON, KURT JAKOBSON SENIOR STAFF ENGINEER

Jakobson welcomed the attendees and extended greetings from Stephan Gage. After outlining the types of discussions hope for, Jakobson expressed the desire for closer cooperation between the EPA and the oil shale industry.

DOE, JACKSON GOURAUD, DEPUTY-UNDERSECRETARY FOR COMMERCIALIZATION

Gouraud outlined the steps DOE is taking to get a commercial oil shale industry underway. It is expected that the $3.00/bbl tax credit will be enacted by this session of Congress, and hopefully, with this inducement, the industry will move forward.

Gouraud believes that the development of a ±50,000 BOPD modular commercial facility by 1985 represents a sensible approach. He stressed that an oil shale industry is needed, but it should only be developed through proper testing to assure that extensive damage to the environment does not occur.

COLONY DEVELOPMENT OPERATIONS, LES LUDLAM, MANAGER

Ludlam reviewed the history of the Colony project. It began in 1964 and progressed through the completion of a semiworks Tosco II retort capable of processing 1,000 ton/day of oil shale. A design of a commercial-size plant was begun by C.F. Braun and Company in 1972. Construction of a 60,000 ton/day commercial complex was to have been started in 1975, but inflation raised projected costs from $350 million to $900 million, and construction plans were suspended.

Since 1974, Colony has worked to maintain its ability to reactivate construction plans. They have continued the required permitting process.

Ludlam reviewed Colony's environmental work and pointed out some of the problems encountered with air quality, water quality, and solid waste disposal. He advocated methods where industrial-scale impacts could be accurately measured.

EQUITY OIL COMPANY, PAUL DOUGAN, COOPERATIVE SECRETARY

Dougan reviewed the plans for the Equity/ DOE experiment in the Piceance Creek Basin.

Steam at 1,000°F and 1,500 psi will be injected into the leached zone to retort the oil shale in place. Over a two-year period approximately 1 trillion BTU of heat will be injected.

A typical five-spot well pattern, with spacing of 68 feet between injection and production wells, will be utilized. A bottom hole temperature between 900°F and 950°F will be maintained.

Dougan described the experimental plans and the environmental analysis. Environmental impact of this "true" in situ process would be expected to be minimal, since natural gas is the fuel and all gaseous products will be burned. It is hoped that the experiment can be started early this year.

GEOKINETICS, STEVE MANKOWSKI
STAFF ENGINEER

Mankowski discussed the Geokinetics/DOE experiment in Utah. An in situ retorting process designed for thin shale beds with no more than 150 feet of overburden is being used. The shale is about thirty feet thick and yields 20-23 gal/ton.

Retorts are prepared by heaving the overburden with explosives. To date eighteen retorts have been prepared and eleven burned. Total production has been about 5,000 barrels of oil, which represents 50% recovery from the broken shale.

MULTI MINERAL CORP., BEN WEICHMAN,
PRESIDENT

The Multi Mineral Corporation has proposed a joint test, with the government, of their integrated in situ process. Weichman believes that their process is ideally suited for the lower shale zone of the Piceance Basin, which contains nahcolite and dawsonite.

In the Multi Mineral proposal, the eight foot diameter shaft drilled into the oil shale by the Bureau of Mines would be used. A bulk sampling program would be conducted to produce about 5,000 tons of nahcolite for use in a full-scale power plant scrubbing experiment. In addition, they would mine out stations for rock mechanics measurements in the lower zone.

OCCIDENTAL OIL SHALE, BILL MCDERMOTT,
EXECUTIVE VICE-PRESIDENT

Occidental began actual work on the "C-b" tract in November 1977. Two large production shafts and a small ventilation shaft are scheduled for completion in January 1981.

Environmental monitoring is continuing. About 250 people are now working at C-b. This force will grow to about 400 by midyear. Traffic problems have been reduced by providing three-shift bus service to the site from both Meeker and Rifle.

McDermott reviewed the work on in situ combustion at the DA site. Retort #6 is currently being burned. This retort is 52 inches square by 260 feet high, and it has produced 23,000 barrels of oil. It is currently producing about 300 BPD.

Occidental is deeply involved in an economic evaluation of C-b. There is concern about changing conditions, as well as potential EPA regulations, that may affect the economics.

RIO BLANCO OIL SHALE, BLAINE MILLER,
PRESIDENT

Miller reviewed the status of the Rio Blanco project. The modular development phase of this project has begun, entailing the preparation and burn of five retorts ranging in size from 30 × 30 × 140 feet to 100 × 100 × 400 feet. Several rubbling schemes will be tried in order to optimize particle size and permeability distribution. Plans call for obtaining sufficient retorting data by 1982 to enable a decision on proceeding with a commercial plant. If favorable results are obtained, a 76,000 BPD plant would be constructed, with scheduled operation beginning in 1987.

SOHIO NATURAL RESOURCES,
HARRY PFORZHEIMER, PROGRAM DIRECTOR

Pforzheimer reviewed Sohio's involvement in oil shale and the experience leading up to and through the Paraho design and operation. He discussed the various types of incentives that could be used by the federal government to help in the development of an oil shale industry.

Pforzheimer does not believe that the environmental problems are insurmountable, and, therefore, believes that we should proceed to commercial-size modules. This would provide government and industry with real data for a rigorous evaluation of the economics of shale oil production and any potential environmental impacts.

SUPERIOR OIL COMPANY, JOHN KNIGHT
ASSISTANT DIVISION MANAGER

Knight reviewed Superior's development of the multi-mineral process. During a five year testing and development project, Superior has

tried to consummate a land exchange program in order to obtain a block of land suitable for an economical mining configuration.

Superior has concentrated on recovery of the dawsonite and nahcolite along with the oil from oil shale. In pilot retorting a circular grate was used with which a high thermal efficiency was obtained (product yields over 98%).

Knight discussed interactions with the EPA and outlined the major areas of concern to Superior. He felt that the lack of long-term stability in environmental laws and regulations was the major problem.

TOSCO, MIKE SPENCE, ATTORNEY AT LAW

Spence reviewed the work that TOSCO had done in trying to get an oil shale project started on its Utah holdings. A unit has been formed, and site development is scheduled to start in 1979.

TOSCO is looking at various problems such as water, transportation, environmental issues, and socioeconomic concerns that must be considered in a commercial project.

UNION OIL, ALLEN RANDLE,
MANAGER OF RETORT OPERATIONS

Randle reviewed the work done by Union in preparation for building a commercial-size retort. There are too many unknowns to justify moving forward on a full size 50,000 barrels/day plant at this time. Instead, a single, full size commercial retort is being considered.

Union feels that the proposed $3.00 per barrel tax credit, if enacted, will allow the building of a single retort module. This will provide better data on potential environmental impacts and full-scale economics. Union has applied for the necessary permits so that is can be ready to proceed when the $3.00 per barrel tax credit is enacted by Congress.

WHITE RIVER, REES MADSEN,
ENVIRONMENTAL COORDINATOR

Madsen outlined the status of the White River project, which is owned by Sohio, Phillips, and Sun. Work thus far has involved gathering baseline environmental data and drawing up a detailed development plan.

The White River project is presently in a holding pattern. It was originally delayed by environmental problems, but now the major problem is land ownership: state vs. federal. This is currently being considered in federal court.

Madsen presented some recommendations for helping to solve the environmental problem: (1) reduce the number of permitting agencies, (2) complete the EPA guidelines document, (3) revise the ozone standard, (4) resolve how process shale fits in with the Conservation Recovery Act, and (5) put a freeze on compliance standards so that they will not be constantly changing.

DOE-LARAMIE ENERGY TECHNOLOGY CENTER,
ANDY DECORA, DIRECTOR

Decora reviewed the work done under the Talley contract near Rock Springs, Wyoming. The Talley experiment was designed as a true in situ process where the oil shale would be broken up by use of an explosive in a hydraulically fractured system. In the experiment, a 60,000 pound explosive charge was detonated in a 40 foot shale bed at a depth of about 200 feet. The permeablility of the shale following the explosion was not as high as expected, and the contract has been terminated.

COLORADO DEPT. OF NATURAL RESOURCES,
ROBERT SIEK, DEPUTY DIRECTOR

Siek outlined Colorado's approach to getting modular testing and the development of the oil shale industry underway. Ten project roles have been defined to cover the interaction of state and local governments with industry in efforts to develop the oil shale resource. Attempts are being made to simplify interactions of the various agencies and departments and to minimize unnecessary conflicts. Early information on proposed developments is needed so that all who are concerned can be fully informed.

ENVIRONMENTAL ADVISORY PANEL,
HENRY O. ASH, EXECUTIVE DIRECTOR

This panel operates under the Federal Advisory Act. Its members are representatives of departments and agencies of the federal, state, and county governments. Its new membership will include two industry representatives.

EPA-IERL, ALDEN CHRISTIANSON, DIRECTOR,
PROGRAM OPERATION OFFICE

The purpose of the EPA is to maintain and enhance environmental quality and protect human health and welfare. It carries out a comprehensive research program to provide technical data for standards and regulations, standardized methods of measurements, pollution control technology, and methodologies to balance environmental management options against competing needs.

EPA's emphasis on energy related research has increased, with most of its funding going to research in the areas of coal, oil, and gas. Programs related to oil shale are conducted at over one-half of EPA's fifteen laboratories. These programs include instrument development and quality assurance procedures as well as field monitoring.

Christianson reviewed the activities of the various EPA research labs as they affect oil shale development. These labs are interested in determining, as soon as possible, any potential environmental impact resulting from development of an oil shale industry.

EPA is currently working on a guidelines document for oil shale development. This will include preliminary regulatory implications and environmental goals for the industry. It is planned to bring industry into the review of this document. A draft will be submitted to each participant in the early summer asking for their comments. It is hoped that by identifying environmental problem areas early, oil shale development can proceed without delays.

EPA-REGION VIII, TERRY L. THOEM, DIRECTOR

Thoem reviewed EPA's regulatory program. Congress established environmental legislation that also offers a framework for state regulations.

EPA has a research program that provides a data base to enable it to fulfill its regulatory responsibilities. The goals are to protect the environment while allowing growth of an oil shale industry. Under the Clean Air Act, oil shale developers must employ best available control technology (BACT), must not violate the National Ambient Air Quality Standards (NAAQS), must abide by the Prevention of Significant Deterioration (PSD) regulations, must not degrade the visibility in Class I areas, and obtain baseline data prior to applying for a PSD permit.

Thoem also discussed other legislation, including the Clean Water Act, the Safe Drinking Water Act, the Resource Conservation and Recovery Act (RCRA), and the National Governmental Policy Act, which regulates pilot module oil shale facilities to insure compliance with existing standards.

After a presention of suggested interim guidelines for air, water, and solid and hazardous wastes, Thoem discussed a number of issues that have been raised in the past by the oil shale industry. These included: (1) number of permits, (2) high background air quality levels, (3) inclusion of fugitive dust, (4) concern over soon-to-be proposed New Source Performance Standards (NSPS) for electric facilities using shale oil, (5) definitions of hazardous wastes, and (6) uncertainties in the regulatory framework.

There has been concern that the EPA's rules are not clear or concise. The EPA is trying to remedy this by preparing the oil shale guidance document discussed by Christianson. Because of our need for petroleum, the EPA supports the limited development of oil shale.

GENERAL DISCUSSION

A number of questions were asked regarding the regulations and their interpretations. These are covered fully in the minutes along with discussions of what this forum could do to improve communications between industry and the EPA.

A brief disussion of the permitting problem was presented by Harry McCarthy of SAI. Under contract to DOE, a pert chart has been prepared for obtaining permits required by the various agencies.

Further discussion ensued about the EPA oil shale guidance document and how industry could contribute to it. A draft of the document will be submitted to the participants, before the next meeting, for review, and it will be a subject for discussion at that meeting. The time frame for completion of the document is early summer 1979.

The meeting was opened by Henry F. Coffer, chairman, at 9:00 a.m. Attendees, listed in the Appendix, were asked to stand, to introduce themselves, and to give their company affiliation.

Henry Coffer welcomed the seventy-five persons attending. He announced that eleven companies working on oil shale projects would present talks describing their present status and their plans for the future. The talks will include an emphasis on environmental problems and other concerns. He said the meeting was designed to encourage further discussions between the EPA and industry.

The first speaker, Alan Merson, Regional Administrator, EPA-Region VIII, was introduced by Coffer.

EPA-REGION VIII, ALAN MERSON, REGIONAL ADMINISTRATOR

Last Friday I met with the governor of Washington, and I think that I well understand some of the concerns about EPA and some of the hostility that may exist with EPA's role in dampening progress in energy development. I talked to the governor at great length to understand their state's feelings about our agency and environmental legislations that mandate our actions.

Basically, I am just a figurehead. I am not a technical person, nor do I have any strong biases. I think EPA positions on issues ought not to be the result of any deeply held personal biases but basically an outgrowth of our mandated legislation. The first principle is one of honesty, recognizing things for what they are.

To begin with, we have to make a statement that mining and the conversion of oil shale are going to degrade air quality, going to consume water resources, may degrade the surface and perhaps even groundwater quality. They are going to create solid and hazardous waste, and they are going to create significant population growth in a rural setting that may not be able to handle it very well. I think that is just recognizing facts as they are. Does that mean that we should not proceed with the development of this resource? Of course not. Any development is going to create problems. The real issue is how we cope with these problems. What is the magnitude of the problem, and what can we bring to bear on solving the problem that will mitigate those impacts. That really is the concern of the EPA, and I do not think it is fair to see us as taking either a pro or antidevelopment stance with respect to this. Your job, in industry or DOE, has a positive obligation to push ahead and explore ways of getting the job done in a fashion that, hopefully, can meet some of the concerns that we are discussing. The kinds of questions that have to be considered, from an environmental standpoint, are:

1. How much groundwater will be intercepted during mining? (Some of these questions are being answered by people engaged in some prototype projects right now.)
2. What will the quality of potential discharges be?
3. Can groundwater quality be protected during and after in situ retorting?
4. Can processed shale be disposed of properly without degrading ground or surface water quality?
5. Will revegetation of processed shale be successful over the long term? (I have had a chance to visit some of the sites in the Piceance Basin and there are examples of revegetation on retorted shale.)
6. What are the concentrations of various sulfur species in retort off-gas streams?
7. What will be the air quality and visibility impacts on the Flat Tops Wilderness Area, which lies east of the Piceance Basin. (In other words, how far can we go in containing whatever air impacts there will be so that the Class I status for that wilderness area is not interrupted?)
8. What are the expected trace element concentrations in air, water, and solid waste residual streams?
9. Is conventional pollution control technology directly applicable to oil shale residuals? Is it effective? (How far can we go to encourage innovations, perhaps at the expense of maintaining levels of quality, with respect to air and water? What is the mix between experimentation and trying to maintain at least a certain threshold of air quality?)
10. What is the expected population growth associated with the development of an oil shale industry?

These are all questions that you have been asking, and that we have been asking. I think the real nut now is to figure out, jointly, the best way to answer these questions. I am convinced that answers can be found. Some can be found without doing anything. You can go out basically with some limited-scope, field investigations doing some theoretical research

work and answer some of these questions. The remaining questions will have to be answered through rigorous testing programs and data analysis performed on representative prototype commercial-scale facilities. It is clear that EPA's position is to have industry construct and operate commercial-scale modules of different surface and in-site retort technologies. Representative mining rates and methods should be evaluated.

We have been asked what size facilities, how much, what would be the maximum that you think could be supported on this basis? We are arriving at about 150,000 barrels per day being a scale that could be reached prior to having the ultimate federal and state decisions being made on additional growth of the industry. We have a lot of confidence in the prototype "Leasing Program." We think it is a well designed program that should proceed to completion before additional leasing is proposed. It provides enough maneuvering room and will provide a good enough basis for answering these questions. We ought to take it seriously, and complete that job before we go ahead and make it a total commitment for a full-scale production.

I suspect that most of you representing industry probably would like to have the answers to these questions as well. We are very concerned about some proposals to proceed to 500,000 barrels per day by 1985. There is a feeling on our part that we will not have the answers to the questions I have recited if we proceed on that basis. There are too many uncertainties associated with oil shale development to permit such a scale this soon. It seems foolish, however, not to proceed with the prototype facilities, with some commercial-scale modules now, so that we get the answers we need. In talking with Governor Ray of Washington, while she is very prodevelopment and concerned with rapid development of energy resources, she is also zealous to guard state prerogatives in resource development. It is a tricky area, because we are dealing with both federal and state concerns, and I think there will be a bad atmosphere generated if the federal government appears both on the environmental front and on a prodevelopment to be overriding state interest in this resource. I am interested in hearing from industry and Jackson Gouraud's view about the DOE's approach to the issue. My feeling is that we can work together, and in the interest of the American people, we can proceed now with development to get us on the road to commercialization and also answer the environmental questions.

EPA-WASHINGTON, KURT JAKOBSON, SENIOR STAFF ENGINEER

Thank you for showing an interest in our nation's energy future by coming here to Denver to help out with the country's energy technology development. Today and tomorrow we will be discussing those problems that are influencing the commercialization of this country's oil shale development. We will find out what the EPA is doing in research and develcpment to eliminate the problems, and we hope that you will assist us by sharing your evaluations of these efforts. We will be showing you the type of resources that we have available to assist you in solving generic development problems. We will learn how EPA interfaces with the Department of Interior's area oil shale supervisor's office, and which requirements the EPA feels obligated by law to impose on these developments. We will also be given some insight as to our affirmative application processing, which should be generally helpful to you.

We have invited the Department of Energy, which is represented today by the undersecretary of commercialization, Jackson Gouraud. Secretary Gouraud will review DOE's time plans for a commercialized industry evaluating his priorities with respect to priorities of other emergent energy technology and world energy supplies. The purpose of this meeting, the first of a planned series of interactions between industry and the EPA, is to enlist your cooperation and join federal/industry efforts that will expedite the collection of information to provide the remaining answers concerning environmental uncertainties.

To the extent that you are willing to commit your firm and to agree that such a commitment is possible, rests the effectiveness of this endeavor. Dr. Gage has asked me to assure you that he intends to take a personal interest in and assume a continuing responsibility for the success of each and every project that we initiate. It is his hope that you will adopt the same philosophy. With this I think we are interested in hearing the technical presentations.

Dr. Coffer introduced Jackson Gouraud, deputy undersecretary for commercialization, DOE.

DOE, JACKSON GOURAUD, DEPUTY-UNDERSECRETARY OF COMMERCIALIZATION

I would like to discuss with you DOE's position on oil shale. I respect the modesty of Alan Merson's comment that he is a figurehead. It is my impression that an EPA regional administrator has more power than do most agency secretaries, and there are times when I wish we had the solid clout he does.

Last April, I met here with representatives of the oil shale industry as well as the EPA, and listened to statements of what industry wanted in the way of oil shale support. At

that time, industry stipulated that if the federal government would allow a $3.00 tax credit and provide entitlement treatment for oil shale (if there is still an entitlement program), these would be sufficient to move the industry forward.

As we all know, the oil shale industry has been about to move forward for the last twenty years, but has never really taken any substantive steps to do so, despite various efforts that have been made. So we incorporated the industry statement into formal legislation to be presented to Congress in February along with a supporting Environmental Impact Statement.

As far as I know, we are doing our part. If you do not do your part, it will probably be the last time we can be led down this "garden path."

As recently as three weeks ago, members of Congress said, "I don't believe it. They'll just say three dollars; then they'll turn around and say four, and if they get four they'll want five." I personally called half a dozen of the companies that are represented here, and had assurance that they intended to move with this credit if it were allowed.

As you know, since April we have been structuring what I consider an intelligent effort with respect to commercialization. We have defined those technologies that we think are important to pursue. The secretary identified eight of them as winners. Oil shale was not included for a reason that I will mention shortly.

We have appointed a resource manager (industry refers to this position as "product manager") to head each technology, giving a point of focus within the department to each. This is expected to encourage development. Shale oil production is one of these technologies.

In all the documents written--concept statement, readiness report, etc.--as well as in the government's role and our own perception of reality, the environmental issues absolutely govern. The development must be carried forward from an environmental point of view; otherwise, it just will not happen.

I should say at this point that we do not sustain any such unrealisitc goal as half-a-million barrels per day by 1985. The department is perfectly prepared to accept your 150,000 barrels per day as a reasonable goal for 1985. I absolutely endorse the concept, along with Secretary Schlesinger, that we have to have in place a reasonable commercial facility. Hopefully, too, the EPA can make intelligent appraisals of the technology.

Obviously, the State of Colorado is critical. We are very conscious that no one is going to allow an influx of larger numbers of companies working in the western portion of the state in an unstructured and uncontrolled manner. DOE will not support it; the governor will not support it, and I do not think you gentlemen are going to allow it.

I believe, however, that in the low six figure range (under 150,000 barrels) we can get a couple of plants going, get other modules on test, and hopefully have a commercial plant with both in situ and surface retorting working by 1985. The legislation that is going forward will have a sunset clause, in that if you are not in business by a given date, possibly within the 1980 decade, you will not be entitled to the same treatment. There also will be a phase-out with respect to the price of oil.

Additionally, Congress appropriated $15 million to move ahead with other projects. The intent of Congress was clear, and these efforts will all proceed in tandem. What I would like to see developing in respect to the state, the EPA, and industry, is careful, prudent, organized progress on what must be developed in this country. We have to have an oil shale industry, but we must develop it properly so that everything else does not spoil in the meantime. That is the position of the Department of Energy.

We can only do so much. We can create budget incentives; we can encourage industry to move; we can take a position in regard to the State of Colorado and work closely with its people. But we are not going to do anything that the Environmental Agency of Colorado would find objectionable.

I trust that I have clarified the position of the government on this matter. Many people are interested, myself particularly. We will do what is sensible. We really do need some sort of mechanism at your level so that we can frequently touch base with each other to keep up with what is going on.

Question: (Dick Lieber, Rio Blanco Oil Shale) Due to limited development by 1985, we believe that it will be too early to get any significant production by the late 1980s. Consequently, we will not be able to take advantage of the $3.00 tax credit incentive.

Answer: I appreciate your point. We are trying to get production by 1985, and we want to assure that companies will be protected in their early investments. We will try to work out the necessary language to accomplish these goals.

Question: (Bill Daniel, Tenneco) Are you contemplating any barrel limit on tax credit?

Answer: No.

Question: What are your thoughts on phase out and price level?

Answer: From $20.00 on a sliding scale.

Question: (Bill McDermott, Occidental Oil) In regard to the $20.00 phase out, are you realizing that by 1985 with the 7% escalation per year, the price of oil will be over the $20.00?

Answer: We understand this and will take this into consideration. We will not give you any package that you are not going to respond to.

Question: (Harry Pforzheimer, Sohio Natural Resources) I supported the $3.00 barrel tax credit but only as one of the number of incentives that I feel are needed. Some of these plants will not be profitable at all or slightly profitable. A $3.00/barrel tax credit will not be any good to a company that is simply going into the oil shale business. It will help a major integrated company only if they have taxable income from other operations to offset the $3.00 tax credit. The most aggressive of the major companies in order to comply with the Department of Energy, are drilling all over the U.S. and the world and are creating tax deductions that result in many of these companies not paying any taxes at all. The tax credit will not help them either. I am still very much in favor of this as it will help some people, but to draw the conclusion that DOE has drawn, that this is all we need and industry must therefore comply once we get it, I think is erroneous. You have to follow many of the other incentives that are proposed and are available.

Answer: I assure you that at DOE your position is recognized. We understand, and this is true of every technology we deal with, that there is not any one answer to the way we approach these problems.

Question: (Mike Spence, TOSCO) You mentioned you had $15 million and knew what you were going to do with it. I wonder if you would elaborate on that?

Answer: The Interior Appropriations Committee directed that the funds be used to solicit industrial interest and design studies to secure engineering plans for module construction. Those portions of the department that have direct responsibility for this, including ET, have come in with specific recommendations. These are in the hands of the undersecretary who will make that decision within a few days. We are really interested in design studies. This will be public information by the end of February.

Question: (Hank Ash, Interior Department) In your DOE selection of eight winners, oil shale was excluded. Was that for environmental reasons?

Answer: The technologies defined as winners were: enhanced oil recovery, unconventional gas, industrial atmospheric fluidized bed, wood, conservation, and three types of solar--passive, hot water and industrial processed heat. These were characterized as technologies that no longer need more research and development or support. Therefore, they were technically ready. However, they may possibly need other incentives to get them going. The contracts will be issued October 1 of next year on a floor-sharing base. But these technologies were all technically there. DOE has to get funds to take care of start-ups. It seems inaccurate to say that shale from an in situ proposition is "there." Before shale is declared a "winner" and given a green light for rapid development, a great deal more data must be assembled and evaluated.

Henry F. Coffer introduced Les Ludlam who gave a report on the status of the Colony project. He talked from slides, but provided a copy of his remarks, which follows.

COLONY DEVELOPMENT OPERATIONS,
LES LUDLAM, MANAGER

I am delighted to be here today and to have this opportunity to tell you more about the Colony Development Operation. I would like to tell you where Colony stands today with respect to our commercialization plans.

Introduction

The Colony Development Operation is a joint venture of Atlantic Richfield Company and Tosco Corporation. Since the venture was formed in 1964, a total of about $75 million has been spent on development, demonstration, and commercialization. This does not include purchase of the reserves.

From 1969 through 1972 the venture revamped from the 1,000 ton/day semi-works Tosco II retort built in 1965. Testing was undertaken in 1971-72 to demonstrate retort operability and to obtain data necessary for the design of a commercial mining, retorting, and upgrading complex. These further operations, which lasted until May 1972, included over 100 programs to assess the potential impacts upon air, land wildlife, water, vegetation, and socio-economic conditions that could result from construction and operation of a commercial complex.

Studies included exhaustive documentation of existing conditions, determination of design parameters for pollution control equipment, mathematical modeling of air pollutant dispersion, and so on. The information obtained from environmental assessments was utilized in the engineering design of the commercial facility.

For instance, Colony originally intended to locate retorting and upgrading facilities in Parachute Creek Valley, but diffusion modeling and a series of tracer studies led us to the conclusion that "trapping," or stagnation meteorological conditions, might occur, resulting in unacceptable concentrations of air pollutants. As a result, we relocated the plan on the plateau.

Following completion of semiworks programs in 1972, we retained the engineering firm of C.F. Braun and Company to prepare a definitive design and cost estimate for the commercial plant, to be located on the plateau, at an elevation of 8,200 feet. The mine portal bench and primary crushing operation will be at the head of Parachute Creek, approximately 700 feet above the valley floor.

Disposal of processed shale takes place in nearby Davis Gulch. A product pipeline would leave the property in a westerly direction. Access to the plant and mine will be by way of Parachute Creek Valley. This corridor can contain vehicle traffic, a water pipeline, etc. Office and terminal facilities will be located to the north of the town of Grand Valley.

Looking closer at the commercial complex, we expect to mine approximately 66,000 tons per day of ore, using conventional room and pillar techniques. The mined rock will be crushed to a nominal nine inch minus at the mine portal, conveyed through an inclined tunnel to the plateau, stored in an open storage pile, and then crushed to a nominal one-half inch minus size before being fed to the retorts.

The retorting operation will utilize the Tosco II process. There will be six of these units in the complex, each having a capacity of 11,000 TPD. Raw shale oil will be upgraded on site, producing a premium quality fuel suitable for a number of different markets. This product is then transported by pipeline.

Disposal operations will require that processed shale be placed in an embankment and then compacted. The compacted shale is quite dense, and is not susceptible to significant percolation, so that it makes an ideal landfill that can be used for the disposal of other solid wastes.

Control of surface runoff requires the construction of catchment dams; the water will be recycled, so that there will be no water discharge. Dust emissions will be controlled using water on all working surfaces, and all permanent surfaces will be revegetated for long-term erosion control.

By 1974 we had expended over 400,000 engineering man hours in the development of this design, with necessary equipment specifications, schedules, etc. for a 66,000 ton/day commercial complex. We planned to start construction in 1975. During 1974, however, inflation had caused the cost of the project to increase from $350 million to about $900 million.

At that point, it was necessary for us to suspend our construction plans, except for the completion of a pioneer road to the plateau and a railroad spur in Grand Valley. Plans to begin construction have remained suspended

since then. Since 1974, we have worked to maintain the venture's ability to reactivate construction plans. A number of approvals and permits have been obtained or are being sought.

Colony must obtain a large number of permits or approvals from the federal government, and we are seeking the critical ones. The Bureau of Land Management completed Colony's final environmental impact statement in June of 1977, after about three years preparation. They will be the permitting or approving agency for our pipeline right-of-way across public lands, as well as for rights-of-way for power lines, access roads, etc., which cross public lands.

The U.S. Army Corps of Engineers must grant permits for river and stream crossings, and for the construction of a water pump station on the Colorado River. We have completed these applications and have submitted them. Colony will need some water from storage to supplement its commercial direct diversion rights from the Colorado River. We have requested that the Bureau of Reclamation reopen contract negotiations.

The EPA must approve spill prevention, control and countermeasure plans, and must grant a "PSD" permit to assure the prevention of significant air quality deterioration. We submitted this application last June.

There are a number of isolated parcels of federal land within our property. A proposed land exchange with the federal government to eliminate these windows is now nearing completion.

There are another twenty or so approvals required at the state and local levels, and again we are proceeding on those that appear critical at this time.

Our air quality permits from the state were applied for this fall. The application requires the completion of forty-five different forms, which are not required for the federal permit. Our state mined land reclamation plan, which must be approved by the mined land reclamation board, is being prepared now. We expect to submit it in 1979.

Finally, we have received conditional approval from the Garfield County Commissioners for the U.U.D. filed for the new community to be developed in conjunction with our plant. In addition to this, there are about twenty-seven more permits required for this community. My purpose in reviewing these permits is twofold. First, I want to make the point that Colony is well along in acquiring its major permits. But more importantly, I confess the fear that the EPA might conclude that oil shale development may be ready to proceed..."if only we had some more regulations." I submit that we are already regulated at least adequately.

Since the purpose of this meeting is to discuss where EPA oil shale research might best be directed, I will touch on what we think we have learned from all the environmental studies conducted in support of our permit activities.

I would like to cover the areas of air, water, and solid waste disposal. For each of these, I propose to follow the environmental impact statement format of describing what is already there, and then telling you how we might impact upon these existing conditions.

Air Quality

We have baseline air quality data for all of the air contaminants that are currently regulated by the EPA. These are reported for various time averaging intervals to conform to the National Ambient Air Quality Standards (NAAQS).

First, most continuous analyzers are incapable of detecting the concentrations of pollutants that normally exist. We appear to be the proud owners of volumes of expensive data, which are mostly zeros.

I call your attention to the predicted maximum incremental particulate concentration of 28 mg/m^3 (which is far less than can be attributed to any health or environmental effects) no more than once per year at any point off the property. This value, then, as low as it is, does not in any way indicate a persistent or widespread air quality impact. The PSD regulations are a lot more stringent than most people realize in this regard.

Water Quality

The existing water quality of Parachute Creek is easily summarized. The flows in Middle Fork and Davis Gulch, the two drainages to be affected, are each 150-800 acre feet per year, with notable yearly and seasonal variations. Salinity, which is the primary water quality parameter of concern, averages about 500 mg/ℓ.

By the time the creek reaches Grand Valley, the flow has increased to about 20,000 acre feet per year on the average, and salinity has increased to about 1,000 mg/ℓ. The Colorado River flows at an average rate of about 2½-3 million acre feet per year, with an average salinity of about 500 mg/ℓ.

Water requirements for the commercial plant will be about 12 CFS or 9,000 acre feet per year. A very minor portion of this requirement can be satisfied by retaining runoff from Davis Gulch and Middle Fork of Parachute Creek, and/or utilizing any water encountered in the mining operation. Essentially all of this water must then be pumped from the Colorado River to the plant site.

Although Colony has pumping rights from the river, they are not of sufficient seniority to guarantee a continuous supply. We estimate, based upon computer modeling of the river, flow and water demands over a thirty year period, that we need a backup supply of about 4,500 acre feet per year to assure continuous operations through the drier years. This means some supplemental water supply will be necessary from storage reservoirs.

We have requested options for water from existing reservoirs, from the Bureau of Reclamation, and we are also working with the Colorado River Water Conservation District, which would coordinate construction of any new reservoirs.

But secondly, there are occasional values, in the case of particulates and hydrocarbons, which exceed the NAAQS. The high levels of particulates are a result of the semiarid, dusty nature of the region, and the hydrocarbons apparently come from the pine trees and sagebrush. Fortunately, the EPA has judged, administratively, that these "natural violations" of the standards need not be counted against the increments that the plant will be allowed.

The commercial plant will emit about 1,900 tons per year of particulates and 1,200 tons per year of sulfur dioxide. These will result primarily from material handling operations and fuel combustion, respectively. There will also be emissions of hydrocarbons and nitrogen oxides. These numbers look better if they were expressed in tons per hour instead of tons per year.

It provides some perspective to recognize that particulate emissions are about 0.01% of material handled, and sulfur emissions correspond to less than 1% of the sulfur contained in the raw shale oil. These numbers reflect the application of "best available control technology" as required by state and federal regulations. As a point of comparison, these emission rates are about 20% and 1% respectively, of those from the Jim Bridger power plant.

I might add that these numbers are different than those included in the final environmental impact statement. In response to the Colorado Air Pollution Control Division, the EPA, and the New Clean Air Act amendment requirements, we have included estimates of fugitive dust emissions (i.e., dust from unenclosed sources such as storage piles), and we have committed to operating twelve of the principal wet scrubbers with increased energy input, if necessary, in order to meet reduced emission limitations.

Two dispersion models have been used to evaluate the impacts that commercial operations will have upon ambient air quality. The first of these was sponsored by Colony, at a cost of about $250,000 during the commercial plant design phase. The 1977 Clean Air Act amendments dictated, however, that we use models developed by the EPA, at least in the case of particulates and SO_2.

The environmental impacts of our operations of water, aside from the possible construction of a new reservoir (with positive and negative impacts), will be a consumption of one-third of one percent of the average flow of the Colorado River. A very theoretical calculation predicts an increase in salinity of 1/60 of 1% at Hoover Dam when 9,000 acre feet are removed at Grand Valley. During periods of release from storage, the salinity may actually decrease.

There will be some minor diversion of water in the upper reaches of Parachute Creek, e.g., due to the construction of catchment dams. We will, of course, be required to have an approved augmentation plan to protect the rights of downstream users. One might expect an increase in turbidity in Parachute Creek during construction, but this can be minimized by the use of sedimentation ponds, etc. There will be no water discharges from the plant: All process waters will be recycled or used to moisten the processed shale.

In summary, water quality impacts will be pretty minimal.

Solid Wastes

We will have a large volume of solids wastes, primarily in the form of processed shale, to consider. There is more than enough room for the disposal of processed shale in Davis Gulch. Not all of the solid wastes will consist of processed shale. There will be about 1,400 tons per day of dust and sludge collected by air pollution control devices, and there will be 800 tons per day of coke that may not be readily marketable. An average of 3 TPD of spent catalysts and chemicals must also be disposed of or recycled.

But processed shale is by far our major solid waste. Processed shale from the Tosco II process is a fine-grained material, and it is black due to a residual coating of carbon. The addition of about 13% moisture is required for optimum dust control and compaction. When compacted, it forms a crust, and is not susceptible to wind erosion. Still it is necessary to revegetate the processed shale embankment for long-term control of erosion. We have spent more than a decade in developing revegetation technology. More than seventy-five species of plants have been grown successfully.

After compact, the surface is watered to leach naturally occurring salts below the root zone, and it is planted with a mixture of species, including wheat grass, Russian wild rye, yellow sweet clover, flowering saltbush,

and Indian rice grass. The surface is covered with a mulch material to help retain the water and to protect the seedlings from excessive solar radiation, fertilized, and planted with seeds innoculated with essential microorganisms. The plants are watered for the next two years, and then become self-sustaining.

Environmentally acceptable surface disposal methods have ranked high on our list of technology development needs. Since 1965, there have been nine separate disposal embankments developed on the Colony property, eight of which were developed by Colony. Each plot represents one more advance in the disposal state-of-the-art. A need, we perceive, is to demonstrate a combination of the disposal and revegetation techniques developed so far. Colony has budgeted some funds for such a demonstration plot in 1979.

One other area where research could prove useful is in underground disposal of processed shale. So far, we have not seen a method that is not prohibitively expensive and more importantly, one that is significantly better, from a long-term environmental impact standpoint, than surface disposal.

I would like to close by making two points: First, from Colony's viewpoint, there are a number of questions about the impacts of oil shale development that may not be wholly addressed, much less answered, until commercial complexes incorporating mining, retorting, shale oil processing, water supply and other support facilities, product transportation systems, and community facilities are constructed and operated. Beyond some point, modeling and extrapolation will not substitute for "the real thing." I suggest then that the EPA look beyond industry's present development and demonstration phase and attempt to define research programs that could become more meaningful, if data were obtained from full-scale plants. It certainly would not disappoint Colony if the EPA were to conclude that it is desirable for the government to support development of at least a few fully integrated, commercial shale oil complexes, so that industrial scale impacts can be accurately measured.

Second, when we talk about environmental protection, we are in essence talking about regulations, because that is the means that we have available for environmental protection. And surely we all agree we need regulations: That has little to do with my observations that we already have a great many of them.

I propose that it is in order, though, not only to discuss the impact of oil shale development upon the environment, but to consider the impact of environmental regulations upon oil shale development. We must, at least, be aware that this is a two-way street.

Reviewing the more recent Colony history briefly, we resumed semiworks activities in 1969. In 1970, Congress passed NEPA. Suddenly we had new rules and new uncertainties: Must an EIS cover the entire project, or only those portions of it directly requiring federal action? Environmental baseline data were required--how much? Even on private property? And how long will it take for the government to complete an EIS?

And so we began the process of preparing an environmental impact analysis.

Much of the effort was well spent; we learned that there were better ways of doing some things. But much of the effort was expended because the rules were not clear, and we recognized the need to avoid court challenges.

And in 1970, Congress also passed Clean Air Act amendments, requiring the EPA to promulgate new ambient standards and new standards of performance, preparation of state implementation plans, etc. The act provided for multilayered federal/state administration, which left considerable doubt as to who was going to eventually be responsible for doing what, and to whom (or, at least, who was going to be doing what).

But we proceeded with $12 million of design work anyway, feeling that reason must prevail...that was in 1972. But also in 1972, the courts ruled that the "protect and enhance" language of the Clean Air Act required the promulgation of regulations prohibiting "significant deterioration" of air quality in clean air areas. After about two years, new regulations were promulgated, with new layers of administration and review imposed upon permit applicants. Again, there were many unanswered questions and consequent litigation regarding administration, allowable increments, allowable concentrations, measurement technologies, classification of areas, review procedures, etc.

During all of this time, the state of Colorado exercised its right to enact air quality standards more strict than the federal standards. Hearings and amendments bounced around for several years. At the present time, the state standards appear not to present a severe obstacle, but still we need to remember that state prerogatives exist, (and rightfully so); they have the authority to set new rules, too.

Even now, the state is developing a state implementation plan to conform to the 1977 Clean Air Act amendments. It will likely be many months before we can determine the impact of these new regulations. And, of course, we have no reason to believe that a "normal" amount of litigation will not accompany the new

Clean Air Act amendments--a number of suits have already been filed, in fact. We still do not know, then, what tomorrow's rules will bring.

In conclusion, I would like to confess that I only briefly touched on the issue of the day, i.e., "what new environmental research may be required." Instead, I have attempted to develop an argument that many critical concerns have already been analyzed in depth, and that adequate regulations have already been developed for environmental protection. I urge that as the EPA develops research programs and formulates new course performance standards, you thoughtfully consider whether or not the point of diminishing returns for environmental protection has been reached and whether or not the data needed could be better obtained from operating integrated commercial complexes.

Question: (Hank Coffer, C.K. GeoEnergy Corp.) When are you going to build the plant?

Answer: It would take about a year and one-half to get construction underway after a go-ahead decision is made.

Question: What is the $3.00 barrel incentive going to do for you?

Answer: It will help, but Colony will not necessarily go ahead if the tax credit becomes law.

Question: (Jackson Gouraud, DOE) That is not what you told me in April.

Answer: Nothing has changed since we talked in April. It is pretty much the same, but a number of other things have to happen before the project gets underway.

Dr. Coffer then introduced Paul Dougan of Equity Oil Company who spoke on the BX Project.

EQUITY OIL COMPANY, PAUL DOUGAN, COOPERATIVE SECRETARY

Introduction

The "BX In Situ Oil Shale Project" is based upon in situ oil shale research conducted by Equity Oil Company from 1962 to 1971. The project is predicated in one basic premise: In the central portion of the Piceanse Creek Basin of northwestern Colorado, there is a section of oil shale bearing rocks in the Parachute Creek member of the Green River Formation commonly referred to as the Leached Zone, which contains very large reserves of oil in place of oil shale. This section, or Leached Zone, has enough permeability and porosity to permit in situ retorting of the oil shale contained therein without resorting to mining and/or other fracturing techniques to create permeability and porosity prior to retorting.

The purpose of the BX In Situ Oil Shale Project is to demonstrate the technical feasibility of using superheated steam at 1,000°F and 1,500 psig as a heat carrying medium to retort in situ oil shale of the Leached Zone and to provide a mechanism for the recovery of this oil with a minimum impact on the environment.

More specifically, the oil shale will be retorted by injecting superheated steam into the leached zone through an array of injection wells and recovering the steam/water/oil and gas produced from the Leached Zone through an array of production wells. The injection into and production from the Leached Zone will be accomplished in a manner which will promote a diagonal sweep of the entire leached zone. During a two-year period, approximately 1 trillion BTU of heat will be injected into a Leached Zone site, which is 540 feet thick and covers 7/10 of an acre.

The measure of success for this project will be whether: (1) The injection goals can be met; (2) The target amount of oil shale can be raised to retorting temperature; and (3) A reasonable percentage of the retorted oil can be recovered.

The project is being performed under a cooperative agreement between Equity Oil Company and the U.S. Department of Energy. Under that agreement, Equity pays 14% of the costs and the government pays 86%. Equity, as the industrial participant, agreed to perform four basic project tasks:

A. Leached Zone Site Evaluation
B. Laboratory Experimentation
C. Field Project
D. Environmental Research Plan

The cooperative agreement was entered into on March 1, 1977, and the length of the project is estimated to encompass fifty-five months.

The BX In Situ Oil Shale Project site is located in the center of the Piceance Creek Basin of northwestern Colorado. The zones of the Parachute Creek member that have attracted principal interest in the recovery of oil from oil shale are the Mahogany Zone and the Basal Zone containing large amounts of nahcolite, dawsonite, and halite. These zones are for all practical purposes impermeable and nonporous and require permeability to be created if the oil shale of the zones is to be retorted in situ. The Leached Zone lying between the Mahogany Zone and the Basal saline zone is filled with saline water, which is a barrier to certain

mining and retorting techniques that might otherwise be applied, but which is salutatory to the technical approach embodied in the BX In Situ Oil Shale Project.

The Leached Zone varies in thickness, being thickest near the basin center and thinner at the edges. At the BX Project Site, the zone is 540 feet thick and contains oil shale with an average grade of 24.39 gallons per ton.

The intent of the well pattern selection was to develop a central fivespot pattern in full field development, while at the same time using the minimum number of wells external to this pattern to confine it. This need was coupled with considerations of steam injection capacity and the injection rate required in each of the injectors to insure that a bottom hole temperature of 900 to 950°F could be achieved. The pattern is developed with a consistent spacing from injection to production wells of 68 feet and covers a total area of 0.7 of an acre. In the 0.7 acre pattern, there are approximately 636,000 barrels of oil in place as oil shale in the 540 foot thick Leached Zone.

Field Project Equipment

To facilitate the injection of superheated steam at 1,000°F and 1,500 psig at a rate of 57 MM BTU/hour or 2,784 barrels/day (42 gallon barrels) required a reasonably sophisticated steam generating plant, a water treatment plant, water storage facilities, and an instrumentation system to monitor both equipment and project performance. The operating sequence is as follows: Water is produced from the Leached Zone and stored in the water storage pit until it can be processed in the water treatment plants. After treatment in the two water treatment plants, the treated water is stored in five, 400-barrel water storage tanks. Treated water is fed to two steam generators capable of producing dry steam at 1,600 psig and 605°F. These two streams of dry steam are then fed to the superheater where the steam is superheated to 1,000°F at 1,500 psig. From the superheater, the steam is distributed to eight injection wells, the quantity going to each being proportionately controlled by automatic control valves. The steam is injected into the injection wells through insulated 2-3/8 inch steel tubing, which is suspended in 7 inch steel casing perforated at the top and bottom of the Leached Zone. After the steam enters the Leached Zone, it gives up its heat and is produced as water accompanied by retorted oil and gas at the five production wells.

Each production well is equipped with a "gas lift" system to assist in producing the wells at a high production rate. From the production wells, the product stream goes through a free-water knockout and a heater treater to separate oil, gas, and water. Water is returned to the water storage pit for reuse, oil is stored, and gas is recovered for use as steam generator fuel gas. A test separator is included in the production equipment to test individual production wells.

Monitoring of all equipment functions and project variables is provided by a data logging system that continuously logs temperatures, pressures, and flow rates, including the down hole temperatures observed in the three temperature observation wells.

I will briefly describe the elements and theory of the project and then point out the primary areas of environmental concern and what is being done to monitor the environmental effect of the project.

As a part of the BX Project, an "Environmental Research Plan" has been developed. The major concerns that this plan addresses are:

1. Transport and fate of pollutants and gaseous effluents expected to be released by the research facilities
2. Transport and fate of recycled water
3. Changes in ground water chemistry, temperature, and potentiometric head during operations
4. Alteration of the geologic, chemical and engineering properties of the retorted oil shale formation
5. Changes in downstream surface water quality in Black Sulfur Creek

The small number of project employees (five full time operators with a maximum of three on duty at one time) does not create a significant impact on the biological system, health, or social environment of the project area. And in a similar fashion, the small physical area occupied by the project (total of fiveacres) mitigates any significant effect on the project lands or those lands adjacent to the project area.

The two principal areas of environmental concern are the effects of the project on air and water quality.

Air Quality

Fuel is natural gas supplied by Western Slope Gas Company plus produced formation gas. The only pollutant that it now appears may be of concern is SO_2 produced as a product of combustion from burying produced formation gas, which will contain H_2S. Wind speed, wind direction, and temperature will be monitored continuously. Fuel gas will be monitored for composition by periodic grab sampling and chromatographic analysis, and continuous monitoring for total sulphur and/or SO_2 will also take place.

Water Quality

A. Surface--Black Sulphur Creek
   1. pH, conductance, temperature, and flow
   2. water quality analysis
   3. monitoring up and downstream of project site

B. Hydro Geology
   1. Leached Zone (B Aquifer)
   2. Upper Aquifer (A Aquifer)
   3. Alluvium (Ground water)
      a. Use project wells to monitor Leached Zone and Upper Aquifer
      b. Alluvial aquifer monitoring wells
      c. Pond leakage wells

Site specific data will be collected to determine:

1. Transmission and storage properties of the Leached Zone, the overlapping aquifers, and possible interconnection between the two
2. Existing quality of water in the two zones, nearby springs, and adjacent alluvium
3. Rates of flow in the two zones across the project site
4. Accumulation of water from leakage from the process waterholding pond
5. Changes in ground water chemistry, temperature and potentometric head during the operational and post-operational phases of the project

Project rationale is to develop data on this project that can be extrapolated as necessary to estimate impact of commercial development.

Question: What is the difference in permeability in the upper and lower aquifer?

Answer: I think there is a difference but I cannot give you an accurate answer.

Question: I understand that in your program you would plan to reuse the produced water.

Answer: What we do is produce the water from the Leached Zone, put it in a pond, put it through a water treatment plant and use that for make-up water for the boiler. In the water treatment plant we have some waste water, and we have 20% of the water blown down through the steam generator in order to get dry steam. That water in turn is injected back into the Leached Zone in other wells on the project. All the water and all the minerals that came out of the water go back into the same place they came from. There is no discharge at the surface externally other than evaporation.

Question: (Bill McDermott, Occidental) What is your anticipated daily production?

Answer: I did not give a production rate, I said 636,000 barrels of oil in place.

Question: What is the goal?

Answer: I would be very happy if we got 300-400 barrels per day.

Question: (Don Hessling, Cities Service Co.) Did you mention the barrels of steam per barrel of oil?

Answer: No. You can choose any number you want. It becomes pretty clear that if the barrels of oil per barrel of steam go down too far it is too costly to produce, treat, and heat the water to make steam. If we have decent recovery then it is probably workable. We are trying to create an oil reservoir effectively, and that is pretty tough.

GEOKINETICS, STEVE MANKOWSKI, STAFF ENGINEER

Geokinetics is in a cooperative government/industry venture between Geokinetics and the Department of Energy. This was a joint venture between Geokinetics and Aminoil, until recently. The field operations have been going on for about three and one-half years at the site in Utah, and we expect to continue with experimental work until probably about 1982. Our project is located seventy miles due south of Vernal in Book Cliffs. We have about thirty-five employees and their families in a self-contained mining camp on the site. To date we have prepared eighteen retorts ranging from very small size to about 60% of commercial size. We have burned eleven of these to date, and so far it appears that the process will work. We have recovered up to approximately 50% of the oil in the broken shale. To date, we have produced a little bit less than 5,000 barrels of shale oil, of which about half has been sold to a local refinery in Utah. The remainder of this has gone to DOE and DOD for testing.

Let me give a quick rundown on the process. We are using a horizontal in situ retorting process basically designed for thin shale beds under no more than 150 feet of overburden. We see this as a viable alternative to strip mining. The shale we are using averages about thirty feet in thickness and has a yield of 20-23 gallons/ton.

The retorts are prepared by heaving the overburden by the use of explosives. This is

done by drilling a pattern of wells into the shale, loading the shale section of the well with explosive, and simultaneously detonating the explosive in the series of wells. After the shale is broken, the burn equipment is installed and the in situ retorting begins. Air is injected in one end of the horizontal retort, and production wells pump the retorted oil and retort water from the other end. Most of the oil is recovered by pumping, with about 5% recovered from the exhaust gases. Water goes to the holding pond, oil to the storage tanks, and the exhaust gas to an incinerator. After the burn is completed, the equipment is moved to the next location, and revegetation is begun.

Our environmental program includes a baseline study covering plants, animals, subsurface water, air quality, meteorology, and socio-economic and cultural structures of the Uintah Basin and a study of the Uintah Basin. The research program includes a study on how retorting affects the movement and contamination levels of subsurface water.

The exhaust gases from this process are similar to other retorting processes. Any impact of a full-scale industry would be minimal since the operation would be spread over several sections. One problem still being studied is leakage of the exhaust gases from the retort through surface cracks.

By 1982 Geokinetics hopes to have developed a commercially viable process and be producing 2,000 BOPD.

MULTI MINERAL CORPORATION,
BEN WEICHMAN, PRESIDENT

The Multi Mineral Corporation was started last year to propose to the federal government a cooperative agreement for constructing and testing a full-scale module oil shale plant. Multi Mineral was formed as a vehicle so that private industry could raise the money, and we could go to the federal government with the proposal. The corporation was formed, and as of December of last year, we submitted our proposal jointly to the Secretary of the Interior and to the Secretary of Energy for this program. A five-year program was designed to test the integrated in situ process. The basic work in this has been completed. All pilot work is finalized and is ready for a module test. We have not yet had a response from the federal government on our proposal, a program involving about $130 million.

Let me tell you what the program and process is. We did a study to determine what kind of oil production would be required and our best estimate was somewhere in the neighborhood of five million barrels a day. We looked at tar sands, oil shale, and coal. How are you going to get it from oil shale? Four processes are available: in situ, modified in situ, surface retorting, and the Superior/Multi Mineral Process.

What can each one of them do? In situ--nothing substantial; it is still experimental and we cannot see that. The surface plants, if they work as well as they hope, might deliver about one million barrels per day before we get into some logistics problem. The one that looks great is modified in situ, which can theoretically provide the amount of oil needed at costs less than we are paying for imports. However, two problems remain: channeling and the water problems. The Multi Mineral Process stands head and shoulders, economically, above the other, but it also has a problem with logistics.

How much can oil shale do? We made an optimization study and asked what we could expect from each of the four recovery methods, and we were surprised when we found out that oil shale can do it. We found that by integrating the process we came up with a solution that we call the "Integrated In Situ Process." This is a product of the Multi Mineral technology applied to a modified in situ method. The Multi Mineral Process solves the channeling problem as well as the water problem. We do not run into the same logistics barriers in this super-large unit until we get to ten million barrels a day. We think this is pretty good, and we are ready to put our money up to prove it. So we have made this proposal to the federal government to fill a big hole in the oil shale program.

We have different types of oil shale resources. The Mahogany Zone resource that is applicable to modified in situ and surface plant processing; the lower zone oil shale resource is equally as big but also has nahcolite and dawsonite in it. The combination type processes are not amenable to the lower oil shale, nor is the Multi Mineral Process amenable or applicable to the Mahogany Zone. We have to make this point very strongly to the federal government.

Oil shale is the cheapest and the closest to commercialization, so we have to get the most of it. Then we will go to other less acceptable forms of energy to make up the balance. That means that we must have processes tested on the Mahogany Zone; surface processes must be tested, because the modified in situ process still requires surface processing. Each one has to have the opportunity to go into full-scale testing to see what it can do for an optimum program. We must have the Multi Mineral Process because it addresses two timely scenarios, oil recovery and coal clean up. The second scenario is one that will come to a crucial stage sooner than the liquid. We have been saying all along that nahcolite is the best scrubbing agent that we know.

There is a big hole in the federal program for oil shale. That big hole is the lack of real motion in the multi-mineral area of our oil shale resources. This is the hole we are trying to fill. We are trying to go to them with a program that is ready for module testing. We are willing to put up our money because it may very well be the only economic approach that does not need outside support. I think we should have the opportunity to prove it.

Now I would like to disagree with Alan Merson who said we should not put up any more leases until we have tested the two prototype leases--well that is just great for the Mahogany Zone. But it does not tell us much about what we have to know about the lower saline zone. There should be an available lease for testing and proving in the Multi Mineral Process. We have a second and separate program.

We have made a proposal and given a letter of intent to the Bureau of Mines to conduct a program this year in the eight inch diameter shaft out there. I believe meetings are being held today to find out what they are going to do with it. They have before them a proposal from Multi Mineral Corporation to immediately take over that shaft cooperatively with the Bureau of Mines to conduct two levels of testing. The first step of testing is the bulk sampling program. The intent is to pull out about five thousand tons of nahcolite from the Nahcolite Zone from that shaft, to be used primarily in two test areas. The first is that we propose to use a good deal of that nahcolite to support a full power plant as a scrubbing agent. The second one is to supply the Charter Company with a large amount of nahcolite. They are conducting some meaningful tests regarding desulfurization within refineries, which look very promising.

There will also be nahcolite available for other tests and that is the purpose, to make it available for any testing that would be meaningful. The second part of that program this year is to go into the lower part of the saline zone and to cut two stations, two drifts out beyond the shaft pillar. These two test stations would be used to determine rock mechanics and mining health and safety--a number of things we need to do so that we can plan on mine safety regulations for mining the saline zone. We also propose, then, to cut a stope between these two levels and do some testing regarding the Integrated In Situ Process relative to the stope concept of oil shale mining.

OCCIDENTAL OIL SHALE, BILL MCDERMOTT, EXECUTIVE VICE-PRESIDENT

"C-b" tract was originally awarded back in April of 1974 for a bid price of $117 million. Originally the partners were Arco, Ashland, Shell, and TOSCO, and up until recently that had come down to Occidental and Ashland Oil. Ashland Oil has announced their withdrawal effective February 14 of this year. We have started on the tract very similar to what Blaine Miller has explained in the line of predevelopment monitoring, actually got on the tract and started physical work in November 1977, which was over a year ago. Since that time we have erected three test frames, one of which is over the DE ventilation escape shaft and is a fifteen foot diameter shaft. The second is a 313 foot concrete slip form, a head frame over a 29 foot production shaft, and the third is a 178 foot head frame over a 34 foot diameter service shaft. Those head frames were all completed in November of last year.

We have, in the meantime, outfitted those head frames so that we could commence the sinking of the shafts. The first shaft commenced sinking January 16. This is the fifteen foot diameter ventilation escape shaft. We expect that shaft to progress at the rate of about 45 feet per week. That shaft was collared at 65 feet, and we will bottom out about May 1, 1980, at a total depth of about 2,000 feet. The other two shafts are scheduled to start later this year (1979), one about February 1 and the other about April 1. Those two shafts will not be completed until January 1, 1981. We will be using the DE shaft that is to be completed in the middle of 1980 to start some development mining over in the direction of the other two shafts.

We are now continuing with our air monitoring. We have two stations, one on tract, one off tract. This was a reduction from the five we used on the baseline study work. We have another station that is solely erected for measuring total particulates. Recently, in conjunction with C-a and with EPA, we established a station for monitoring visibility sites on and off tract. We have about 250 people working at C-b now, mostly contract people in the shaft sinking operation. That will grow to about 400 by midyear, when we will be sinking simultaneously all three shafts. In the area of socioeconomic, work we are busing out employees from both Rifle and Meeker. We have two buses every shift coming from Rifle, one from Meeker. This is to mitigate highway congestion problems. It also helps out from the air quality standpoint and causes less impact on wildlife. This has been very effective.

About 80% of our employees take these buses. We have some staging areas in both of the communities, and the workers drive to that area and are bused up to the site. (These are new Greyhound-type buses with soft music playing both to and from work.) In the housing area we have provided financing for housing at both Meeker and Rifle and have about fifty units at both places. At Rifle we

have built a 100-pad mobile home court, which is about two-thirds occupied. We opened that up to non-Occidental employees and noncontract employees. That summarizes the activity at C-b.

I would like to say something on DA Shale. (DA Shale happens to be the initials and the name of the man that owned the property before Oxy acquired it, and since his name was Mr. Shale and his initials were D.A., it fits in with the two letter acronyms C-b and U-a, etc.) We are in the process of completing a cooperative agreement with DOE. This was a program that was started back in November of 1976 for a total amount of almost $20 million. This involves the forming and firing of full-scale retorts.

Retort #6 is currently being burned. It is a retort that is 52 feet square by approximately 260 feet high. This retort was fired in September, and it has produced to date about 23,000 barrels of oil. We are looking at the rate of well over 300 barrels a day now. Last winter was not an easy operating winter, with all the zero weather and the power outages we have had, but we have learned to work with these adversities as we are going to have to learn in the high country in the wintertime.

In addition to that, there is a totally Oxy funded program going on at the DA Shale, and that is a rock fragmentation, learning how to blast the rocks. This is a very fundamental part of the modified in situ program. This program was started last year and is continuing well into this year. Some rather large retorts are blasted and tested as far as the permeability. We have about 100 people working at the DA Shale operation, and that will grow. We also have before the DOE a proposal to extend the Phase I program through the development of two additional retorts. This was originally conceived to be done at the C-b site for full production there, but because of the timing it is better to do that at the DA operations at a much lower cost. This proposal would involve the mining, rubblization, and the burning of two retorts simultaneously. That really covers the operations.

Let me make a few more comments. We are deeply involved in an economic evaluation for C-b, having an engineering company doing a full study. The moving target of world oil price is making it difficult in getting a firm grip on what the economics are for an oil shale operation. Also we are a little nervous about the EPA schedule for new regulations. That is hanging over our heads, and we really do not know what is coming down the track. It can seriously effect economics. The other is the visibility study. How is that going to impact the oil shale industry? As for the hazardous substance problem, just where is that going to hit the oil shale industry? (One of our fellows interpreted that regulation to say that spent shale is going to have to be put into 55-gallon barrels and buried underground.) The third one would be the Resource Conservation and Recovery Act. Just what is that going to mean to the oil shale industry? We see in a lot of places that there is wide application of regulation or interpretation of regulations without specific data, and this really hurts. We are working very diligently and with the cooperation of the various agencies to acquire the data that is necessary. We realize the pressure position that some of the agencies are put into at times. It makes us nervous that these broad applications are made when we really do not have the specific data that we need to apply them to the oil shale industry.

RIO BLANCO OIL SHALE, BLAINE MILLER, PRESIDENT

Rio Blanco is approximately one year into what started out to be a four-year test development program and is slowly edging toward four and one-half years. We call it our modular development phase. This program is fully authorized and funded by Gulf and Standard and was expected to cost about $100 million. That figure has risen. Since this is an EPA/Industry workshop, I should probably mention that prior to any significant tract development the two-year environmental baseline data gathering program was initiated at a cost of about $5.2 million. Then we had an interim monitoring program that lasted through the one-year extension period that cost about $1 million. We expect through the remainder of our modular development phase that our monitoring program will cost about $4 million. So you can see environmental monitoring alone is a full 10% of the cost of the program. And, even then, this is not considering the costs of the program for obtaining and reporting on various environmental permits or the tasks of pollution control planning equipment and expense. The point I wish to make is that Rio Blanco is operating a very comprehensive environmental program that we believe is more than adequate to assess the effects caused by our activity.

The modular development phase, as we are currently implementing it, requires a fifteen foot diameter shaft. This shaft gives us access to the retort area and provides for the removal of material that is generated by the driving of drifts and void volume for expansion of the rubble in the retorts. A ten foot diameter shaft is also required for mine ventilation purposes. At the present time our fifteen foot surface production shaft is at 646 feet with a projected total depth of 977 feet, and it is expected to be reached by about midyear.

Although we have had some water, hydrogen sulfide, bad ground, and other problems, the shaft sinking is making rapid progress.

Considerable drifting for horizontal excavation has been done at several levels. The "C" and "E" levels of the shaft and shaft sinking should progress at a rate of about eight to ten feet per day. Once the shaft is completed and equipped, drifts will be driven to the retort area where we plan to rubblize and burn five retorts of progressively larger sizes. The first of these retorts is programmed to be 30 × 30 × 140 feet tall and should be burned in late 1979. The last of these retorts, at the present time, is expected to be 100 × 100 × 400 feet tall, and we anticipate that from this information we will be able to prove the reliability of commercial scale retorts significantly larger than the last one burned during this program.

Several rubbling schemes are under investigation, some of which have the potential of greatly reducing mining costs. The purpose of our modular development phase is to answer the several technological, environmental, and economic questions that we have regarding the process and hopefully allowing us at the end of this program in 1982 to be able to make a commercial decision. Assuming the most favorable results are obtained, the detailed development plans that have been approved by the area oil shale supervisor, call for the construction of a commercial scale plant of 76,000 barrels a day to be in operation by 1987. We believe that this is an optimistic appraisal and that it will probably be necessary to carry out additional modular experiments before we can justify the over $1 billion expenditure needed for a commercial plant. In summary then, Rio Blanco is progressing pretty much on schedule and fully intends to complete the program.

At the completion of this program, Rio Blanco will have more than $260 million invested in tract "C-a," which should give you a measure of our confidence of eventual success. The timing of success is far more questionable, and I personally believe that, in very large measure, is dependent on governmental attitudes. If the government gives a commitment to oil shale development, I believe that commercial production in the 1987 area is possible. If the governmental attitude towards oil shale development is negative, that time schedule will not be possible.

Question: On the first burn, will it be next summer?

Answer: As of the last meeting we have had the burn programmed for September 1, but that has slipped a bit. It will be before the end of the year.

Question. Any daily production predictions?

Answer: No. Daily production anywhere in the modular tests is really not applicable. We are producing about 140 thousand barrels total out of the five retorts.

SOHIO NATURAL RESOURCES,
HARRY PFORZHEIMER, VICE PRESIDENT

Perspective

I have the greatest respect for Jackson Gouraud and Alan Merson not only because they are here and are conducting this program, but because they are willing to come out, spend their time to look at what we are all doing, get first hand information, and draw their own conclusions. This permits them to distinguish between the real and the unreal. To me, the real in oil shale is shale oil. Until you produce a lot of shale oil you are not quite real.

We are not here to talk about the fact that the country has a $15 billion balance of payment deficit. We are not here to talk about the fact that half of our oil is coming from foreign countries. We are not here to talk about the fact that during the Arab embargo, close to 90% of the fuel for our Navy fleets disappeared. We are not here to talk about the fact that if we had another embargo of any duration, we would not be able to muster a significant effort in our own economic or national defense.

We are really here to talk about the environment, conservation, and production. I think we must view these problems in the light of the seriousness of our energy situation. For example, if conservation is a major objective, do we begin oil shale development by starting an open pit mine about where the C-a lease is located and proceed to mine the whole basin? I personally do not think so, but with good above-ground retorting that is the method for obtaining the highest yield of oil from the rock available.

If, as presently planned, we do not do open pit mining, the next best way to go would be underground mining with a combination of above-ground and in situ retorting. The first step would be to mine the rock, put it through an above-ground retort and get a high yield of oil and gas. Then, fragment the rock around the mined out cavities, retort this rock in situ, and hopefully, get another high yield. Any talk here about in situ versus above-ground retorting would be unrealistic and out of place if conservation is an objective.

Sohio became involved in domestic tar sand in 1956 and in domestic oil shale in 1963. Our reasons for doing so were as much strategic as economic. The strategic reason was to reduce Sohio's vulnerability as a major purchaser of crude oil. At that time Sohio's management correctly anticipated that crude oil production in the United States would soon begin to decline

and that worldwide demand would exceed worldwide production of natural crude oil in the foreseeable future. Well, U.S. production has been declining. Our current estimate that worldwide demand will exceed worldwide production by 1989 is beginning to look overly optimistic.

Sohio had not been sufficiently successful in its crude oil exploration efforts prior to 1963 to improve its ratio of crude oil production to refining. The billions of barrels of oil in-place in the tar sand deposits of the United States made a very large and tempting target. The trillions of barrels of oil in-place in the U.S. oil shales, particularly in the Green River formation of Colorado, Utah, and Wyoming were a larger and more tempting target. We felt our strengths, at that time, were in refining and marketing. We also had a pretty good reputation in secondary crude oil recovery using unique production techniques. We wanted to capitalize on our capabilities and try to correct our weaknesses.

Everything changed for Sohio in 1969 when Sohio acquired British Petroleum's interest in Prudhoe Bay. We have had to develop that field on the North Slope of Alaska. We, with British Petroleum, own a major portion of the trans-Alaskan pipeline. Sohio put $6 billion into Alaska. Just prior to our involvement with British Petroleum, Sohio was an $800 million corporation. During the past 10 years, the company has grown into an $8 billion corporation. This has required a phenomenal job of financing. Most of the growth was realized by borrowing money which must now be paid back with interest. Very large increases in Sohio's revenue will be required to accomplish this.

Sohio has evolved as a major domestic crude oil producer. This has not in any way dimmed its interest in oil shale and tar sand. Our preliminary economic analyses, going back to 1963, indicated that oil shale development had a certain amount of justification. This was based on the assumption that a workable process could be developed. Our general objectives from the very beginning have been to acquire oil shale reserves, develop workable processes, and get into commercial production. These objectives have not changed.

Our projections for oil shale commercialization have been periodically upgraded. We know from the work that we have done, particularly with Paraho, that the economics are improving. These benefits have been due, in part, to the success of our field work. It has also been due, in part, to the legislative and administrative actions that we have helped obtain for oil shale and tar sand at the state and federal levels.

What has been accomplished in the legislative and administrative areas? We obtained exemption from price control for shale oil. We got shale oil qualified for entitlements. We originally thought that when we obtained the price control exemption that we automatically qualified for entitlements. However, we found out with a change in administration that one had to go through the action of getting it qualified. So we went through the actions. Shale oil and tar sand oil are now qualified for entitlements. In addition, the last Congress approved an extra 10% investment credit.

In generating economic figures for a hypothetical commercial oil shale plant, we must assume that the process works. This has never been demonstrated in a full-size, single module for any of the candidate processes. But, if you make that assumption for a cash flow paper study, you will find that it takes about 10 years of operation of an oil shale plant before you run out of tax deductions and tax credit. Only then would you begin to look for something like the proposed $3.00 a barrel tax credit. It takes a long time in an investment intensive business, such as oil shale, before you finally run out of tax offsets.

The new extra 10% investment credit did not noticeably improve the marginal economics of a hypothetical, pioneer oil shale plant run as a corporation. But, such a plant run as a venture by a profitable parent company or by a group of companies would show an improvement. This assumes other taxable profits are available. Then the extra 10% investment credit could be taken directly into the parent company or companies year by year. This improves the economics of the oil shale plant for a venture. Such a venture could use both 10% investment credits and the proposed $3.00 a barrel tax credit to help make the shale oil plant look more attractive. However, there are a lot of companies that may not be able to do this.

Another bill passed by the last Congress covers alternate fuel acceptability in lieu of coal conversion. That is, you could use shale oil or tar sand oil, if they were available, as boiler fuel instead of having to convert to coal. Conversion to coal can be very expensive. This bill is going to help shale and tar sand some time down the road.

Recently, the government participated in funding a 100,000 barrel shale oil production, shipment, and refining program. The production was done by Paraho and the refining by Sohio. Both programs have been completed. Important progress was made. We are ready to scale-up the Paraho technology into a single, full-size module.

Finally, by way of Congressional action, $15 million was appropriated by the 95th Congress to initiate a full-size, above-ground module program. There are still some risks involved even with the Paraho process. We

should scale-up one or more processes that have been demonstrated in semiworks equipment to module size before proceeding to commercial production. The Congress has already provided the Department of Energy with the necessary tools to get started. The Governor of Colorado is dedicated to the module concept for oil shale. Gradual oil shale development would be desirable. This is true not only from the government's point of view but also from industry's point of view. We never know who is going to stab us in the back next. As a result, we do not want to have too many billion dollars on the table. As a matter of fact, we do not even want to have too many million dollars on the table. So, we do need stability and additional safeguards. We need incentives. We need to know that the government really wants us to proceed with oil shale development. No better indication could be obtained than the DOE's implementation of the joint government-industry funded, above-ground retort module program.

Many of the people here have talked about the technological and the environmental aspects of oil shale. I will go a little bit more into the policy and political side of it. I do not mean to say this in a disrespectful way, but there have been less than friendly and often illogical government postures toward oil shale. Industry will get going in one direction, such as the prototype leasing program or the Paraho Oil Shale Demonstration, and all of a sudden something gets in the way. I have tried to identify what caused these changes without success. There has got to be somebody in there somewhere that is saying, "Let's change the signals." When this happens it usually shuts off on-going programs or operations which are moving ahead at a reasonable pace. I hope this does not continue to happen.

In addition to the $3.00 a barrel tax credit, which I pointed out will be helpful in certain circumstances to certain people, there are other things that need to be done. Above all I think the DOE needs to implement the $15 million program which Congress has already approved. This should be done before we go back to Congress and ask for more. This would certainly get some people going who are not attracted at all by the $3.00 a barrel tax credit.

Let's also support the Department of Defense which has favored large guaranteed purchase contracts at prices high enough to encourage shale oil production. One problem with a purchase contract for shale oil is that you cannot "bank" it because bankers will look at it and laugh at you since nobody has ever run that kind of a facility before. Bankers are not about to lend money using as collateral a plant that they are not sure will work. One way we may be able to help borrowers convince bankers that a proposed oil shale plant is good collateral, is for the developer to be able to show that he is going to use a process that has been successfully demonstrated in a full-sized module. Here are the results of the demonstration. This process does work. The only other way is through a government guaranteed loan. However, such loans will be helpful to some people, but they are of little attraction to the major companies. It is alright to be able to say you can fall back on the government to pay the debt in the event the plant goes bad, but major companies could not afford to let that loan go bad and hurt their credit rating.

To summarize, there are many incentives needed to encourage oil shale development by a wide range of different types of potential developers. I believe they should have a wide range of incentives from which to choose as it is very important to this country to begin oil shale development in an orderly fashion now. Progress in this regard is being made in obtaining incentives. We already have:

1. Exemption from price controls and qualification for entitlements. Both of these will be phased out with the phasing out of crude oil price controls.
2. An extra 10% investment credit in addition to the normal 10% investment credit.
3. Acceptability of shale oil as boiler fuel in lieu of converting to coal.
4. The $15 million appropriation to initiate a joint government-industry, above-ground oil shale module program. Its early implementation by the DOE, using its existing authority, is needed.
5. Loan guarantee authority, but no appropriation.

Unfortunately, the Department of Energy is not making full use of the tools we already have. As a result, little of substance, little that is real, is being accomplished.

Now we are proposing the $3.00 a barrel tax credit as an additional incentive. While I agree with this, I do not feel it should be done to the exclusion of the already approved joint government-industry funded module program nor to the exclusion of loan guarantees or purchase contracts. We need to get the Defense Production Act extended and the purchase of crude shale oil and synthetic crude included. It was unwise last year to get hung up trying to pass only one thing, the $3.00 a barrel tax credit. Let's not have to regret making the same mistake twice. With a well structured, diversified incentive program, we can minimize our maximum regrets.

Status

Since 1963, Sohio has acquired a very significant spread of oil shale properties and

water rights in Colorado and Utah. Much of this property is held jointly with other people. One of our ventures is the White River Shale Project, which we jointly support with Sun and Phillips. Rees Madsen will talk about the White River Shale Project. Sohio holds the U-b lease which is dedicated to the White River Shale Project. We also hold the Skyline #1 and Skyline #2 properties which are adjacent to the U-b lease. Sohio and Cleveland-Cliffs Iron Company hold the Pacific property in Colorado. We are in these ventures because we mean to do something about oil shale if the incentives are right.

Although we are no longer a member, Sohio organized Colony Development in 1964. Colony attempted to demonstrate the TOSCO process. The results were not encouraging enough for Sohio to be willing to join with TOSCO and Arco in their proposed commercial plant. This plant was deferred indefinitely in 1974 and has remained just over the horizon ever since.

In 1971, Sohio began to organize the Paraho Oil Shale Demonstration. That group eventually included Arco, Exxon, Texaco, Mobil, Shell, Amoco, Chevron, Marathon, Phillips, Sun, Gulf, Southern California Edison, Kerr McGee, Cleveland-Cliffs Iron Co., a group of independents headed by Webb Resources, and Arthur G. McKee & Co. Most of these people joined the Paraho group only after making a thorough study of what was going on. They have had a significant influence in the Paraho operations. However, they do not own Paraho, which is still a small business, but they have the right to license the Paraho oil shale process at a very reasonable royalty rate.

We think the success of the Paraho Oil Shale Demonstration, including a small 10,000 barrel refining program conducted by the Navy, led to the DOD/DOE program to produce, ship, and refine up to 100,000 barrels of Paraho crude shale oil.

Since the completion of the 100,000 barrel program, which was terminated prematurely by the DOE, Paraho has phased out its operations. It was necessary to release a great number of Paraho's people because the $15 million appropriation to initiate a full-size module program was not being implemented by the DOE. Paraho has been able to pick up a minor contract to terminal all of the shale oil for all of the other projects that the DOE has been sponsoring. These other projects are all in situ projects. This oil is costing a great deal more to produce than was Paraho's oil. We think in situ can make a very important companion contribution to the conversion of oil shale to shale oil. But, we do wish that these in situ people would produce more oil. The amount we have received for storage has made for pretty lean pickings in the storage business.

Paraho has been pushing for a module since 1974. First we discovered that Paraho did not have enough shale mining authority to be able to feed a module. We went to the Department of Interior to get additional shale. The Department of Interior referred us to the Navy since Anvil Points is located on the Naval Reserve. The Secretary of Navy, after conferring with the Chairmen of the Armed Services Committees of the House and Senate, authorized the use of 11 million tons of shale.

We began organizing to build the Paraho module about the time President Ford came out to see us in 1975. We took him through the plant and told him what we had accomplished and what we wanted to do. The President was very favorably impressed and encouraged us to proceed. We think, at this time, we had enough industry support that it could have been done with private funds. A short time after President Ford left, one of the ERDA environmentalists came to Anvil Points. He said that we were not going to be allowed to build a module unless we got an Environmental Impact Statement (EIS). That was in the third quarter of 1975. We advised ERDA that we already had an Environmental Impact Statement and we had designed our proposed module to fit within it. However, the Colorado Open Space Council had written a letter and said that if ERDA did not require Paraho to get an Environmental Impact Statement that they would be sued. ERDA did not want to be sued, so we had to get a new impact statement. ERDA's representatives said they would work very diligently with Paraho and would have the EIS out in nine months. This was in September of 1975. It is now almost 3½ years later. We still do not have the Environmental Impact Statement.

Our new EIS became involved in a jurisdictional dispute between different offices within the ERDA organization. Then the DOE took over. Additional delays followed. The EIS is now in the final draft form. I am told we should have the Environmental Impact Statement about the time we have the go-ahead from the DOE to initiate the module under the $15 million program.

I hope all these module pieces fit together. Alternate energy development is important to our country. We are not trying to do anthing objectionable. We are trying to prove a process. We are trying to do it in the open where everybody can come and observe. If we cannot do it well, then we do not deserve to do it commercially. The same standards should be applied to others. We think everyone ought to have this chance.

In an effort to go ahead with the $15 million program, which the previous Congress passed, Paraho submitted an unsolicited proposal to get it underway the day after President Carter signed the bill. We had the

complete cooperation of the Colorado Congressional Delegation, the Governor of Colorado, and all the members of his office. We were ready to go. We had contracts with firm commitments for the industry portion of this joint government-industry funded program with The Standard Oil Company of Ohio, Phillips Petroleum Company, The Cleveland-Cliffs Iron Co. and Arthur G. McKee Engineering Co. These companies all wrote to Dale Myers to let him know that they would back up this program. Unfortunately, while not accepting Paraho's proposal the DOE decided to make a request for proposals. This will delay the program by about one more year.

In conclusion, I believe we have ample justification for doubting that the government, particularly the DOE, really wants us to proceed with oil shale development. If this conclusion is wrong or if the government's position has changed, I would like to see some positive signs to counteract all of the negative signs we have received. This requires that the DOE actually get involved in the above-ground retorting by carrying out the joint government-industry module program, initiation of which has been authorized and appropriated by the Congress. If this is done, and if successful experience in oil shale retorting in the semi-works scale means anything to the government in selecting a process, I am sure Paraho will have a place in the program. Such a program is badly needed and is long overdue. We cannot be sure any process will work commercially until we actually build a module and try it out in full-size.

Dr. Coffer introduced John Knight, manager of the Superior Oil Shale Project. He presented a talk based on slides outlining the multi-mineral processes status. We are presenting it in the minutes along with selected copies of the slides.

SUPERIOR OIL CO., JOHN KNIGHT, ASSISTANT DIVISION MANAGER

Where

Northwestern Colorado on the northern edge of the Piceance Basin about twenty-two miles west of Meeker and thirty-five miles east of Rangley (Figure 1, Figure 2).

What

Multi-mineral process for recovering oil, alumina, nahcolite and soda ash from oil shale (Figure 3).

When

As an historical introduction, Superior's multi-mineral oil shale program entails surface processing for producing nahcolite, oil, alumina, and sodium compounds. Over the past five years, we have constructed and operated pilot plants on all steps in the processing and determined the technical viability and economics involved. However, during this time we have not been able to consummate a 1973 land exchange application to block our lands into an economical mining configuration. Our resource lays in a long narrow L shape that requires prohibitive ventilation, haulage, and access cost. The Bureau of Land Management seems to have made considerable progress in the last six months, which includes an ES preparation, etc., so that a decision on this exchange application can be made. Currently, to maintain our technical staff and position, we are licensing retorting and mineral recovery technology domestically and internationally. We have reduced our number of employees from more than seventy during pilot plant work to twelve key technical people at the present time.

How: Nahcolite Recovery

Nahcolite is separated from the mine run material by a selective crushing and photosorting technique. The nahcolite occurs in nodules in the base shale, and being more friable can be selectively crushed and released from the shale. Commercial size photosorting equipment has been used to separate commercial grade nahcolite from the shale (Figure 4).

Nahcolite has been used in pilot tests as a scrubbing agent to reduce SO_2, NO_x, and particulates form coal-burning electric generating facilities in Colorado and other states. These successful pilot tests hold the promise of reducing emissions in many generating facilities as well as use in various chemcial and refinery clean-up operations.

Oil Recovery

Both circular and straight grates have long been in commercial use for iron ore pellet sintering, cooling, and other kiln applications. Superior's process development effort focuses on adaptation of the circular grate process for oil shale retorting. This effort included construction and operation of an adiabatic fixed-bed retort designed to simulate the conditions encountered by a section of solids as it travels through the separate processing zones in the circular grate. The adiabatic retort tests identified the significant process variables and their effect(s) on cost responses such as through-put rate, thermal efficiency, product yield, etc. Cost sensitivity analyses established optimum ranges in which to design and operate the circular grate oil shale pilot retort, which was later constructed (Figure 5).

The pilot circular grate retort operations defined design and scale-up information for the oil removal system, which had never been tested in prior circular grate applications.

Pilot plant operations also confirmed the mechanical reliability of solids flow on four types of shale. The primary results of this process development effort have been:

1. Attainment of thermal efficiency for the crossflow circular grate that approaches those achieved in countercurrent flow devices
2. Product oil yields of over 98% of Fischer Assay
3. Development of a proved oil recovery system
4. Optimized throughput and gas rates per ton of oil shale processed

These successful process development results can now be combined with the proven mechancial reliability of commercial-size circular grate heating-cooling equipment for oil shale retorting.

Alumina and Soda Ash Recovery

We plan to meet our plant and processing needs for water requirements from the deeper salt content groundwater aquifers. These saltwater requirements total approximately 7 ft^3/sec gross production. They are predominately for the alumina and soda ash recovery processes (Figure 6).

The salt water is used for leaching and washing the retorted shale of mineral content. A mineral rich pregnant mother liquor is produced. Multi-effect evaporators and crystallizers generate water condensate from the pregnant mother liquor in production of alumina and soda ash products. The resulting water condensate is used for the major plant freshwater needs. Minor plant freshwater needs, such as construction drinking water, etc., totaling approximately 0.177 ft^3/sec, will be met from our surface water rights either through irrigation or conditional decreed surface rights. Actual replacement, storage, or exchange for our surface water is in the process of refinement and are not defined at this time.

Environmental

Key environmental aspects of Superior's multi-mineral shale processing are:

1. Use of low quality energy in the mineral winning processes; alumina-soda ash for an overall very thermal efficient interfaced processing complex
2. Return of leached spent shale to the mine (Figure 6-A)
3. Use of salt water from the Leach Zone vs. fresher surface water, thus decreasing salt content in the White, Green, and Colorado rivers
4. No water discharge from Superior's project

EPA Decisions That Affect Venture Economics in General

The actions and decisions of the Environmental Protection Agencies indeed affect all ventures or facilities that produce goods for the citizens of our society and the world. Goods are food, energy, building materials, etc. These are economical effects that determine the bottom line risk evaluation. The venture economics are the real test of a venture's worth to society.

In an economic evaluation and a risk analysis four things are of major concern:

1. Processing risks, engineering risks, and marketing risks are private industries' historical burden of doing a good job in the management and technical areas, so that these investors' risks are minimized to the point they are willing to be accepted.
2. How long will a society allow the investor(s) to own the facility? Stable ownership laws have existed in the U.S. since our birth as a nation. We tend to take stable ownership for granted in the U.S. If society's needs change, compensation is extended to the owners.
3. What will be your yearly rent? Taxes, interest rate of return to draw capital, are fairly straight forward. In a stable society these can usually be predicted for a reasonable economic life.
4. If you obey the rules, laws, and regulations now, will you be allowed to operate and realize production of goods when the unit is started up some years in the future? Thus, do these rules, laws, and regulations have a reasonable economic life?

The effect on a discounted cash flow analysis is essentially the same: if (1) society nationalized your facilities after five years or (2) lets you build the facilities, but does not allow operation or use for five years because it has decided to change the rules.

The lack of stability or long-term commitment by a society on environmental laws and regulations makes risk evaluation very tenuous in this area.

Putting this on a personal basis: our society should view the Environmental Protection Agency as the Environmental Investment Agency. Using savings account as an example of ownership and change in laws:

1. It is easy to understand that a change in ownership laws without compensation can reduce your account to zero very quickly.

2. A change in laws stopping production of goods while your expenses continue can also reduce your account to zero.

Corporate investors do not appreciate their investment going to zero any more than you or I appreciate our personal savings being lost.

The basic concept of early assessment of a venture's effects on the environment is good. Being a third-generation Colorado native who was raised on the Roan Plateau, we in western Colorado should have a reasonable estimate of the environmental impacts; however, a conscious choice of the right to work at facilities producing goods for society, their advantage to our state and national interests, versus existing farming or tourism has to be balanced against the environmental investment.

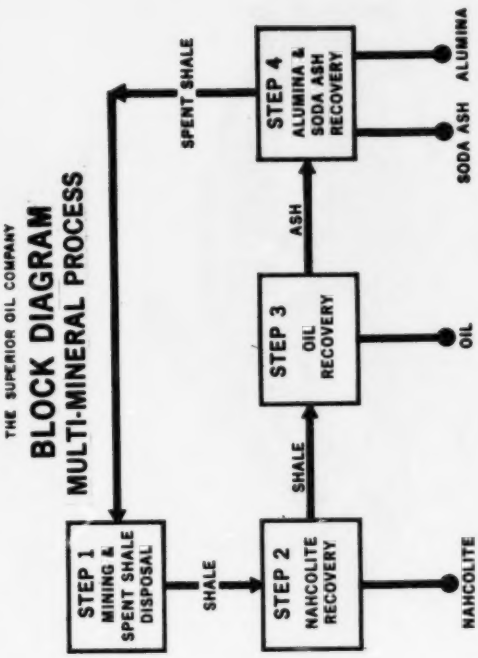

Figure 3. Block Diagram Multi-Mineral Process

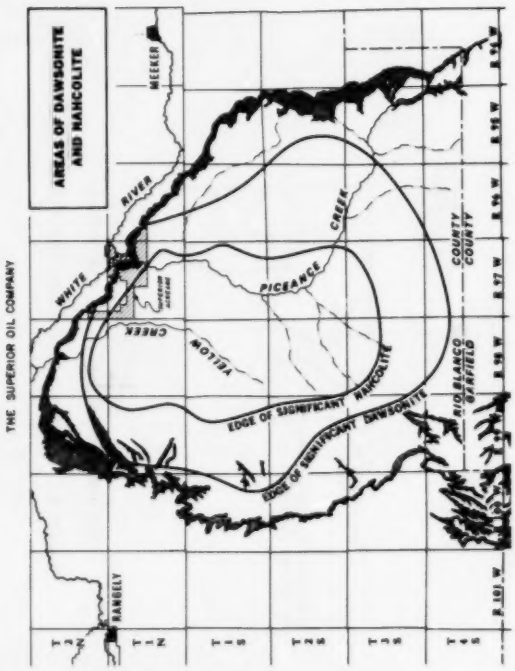

Figure 1. Areas of Dawsonite and Nahcolite

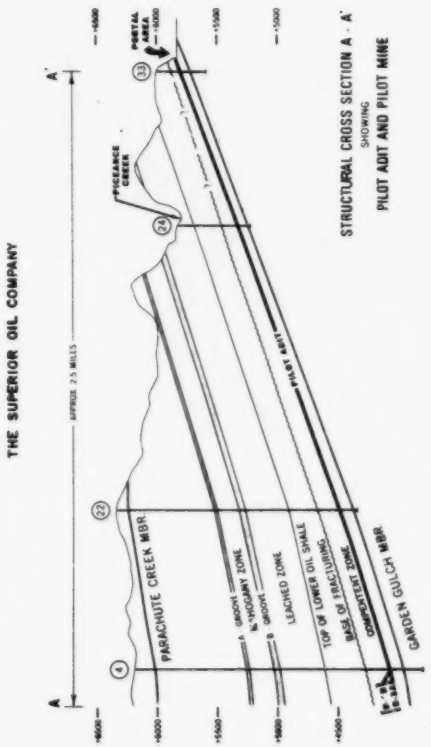

Figure 2. Structural Cross Section A - A'
Showing Pilot Adit and Pilot Mine

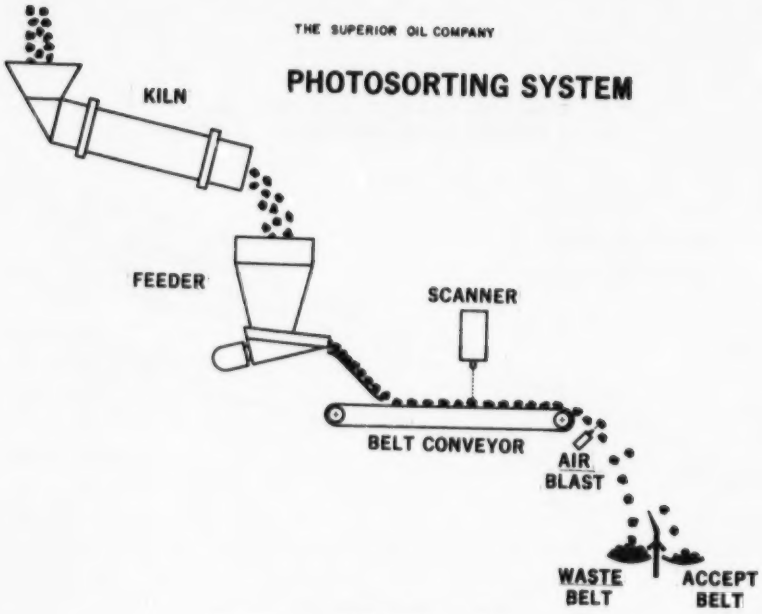

Figure 4. Photosorting System

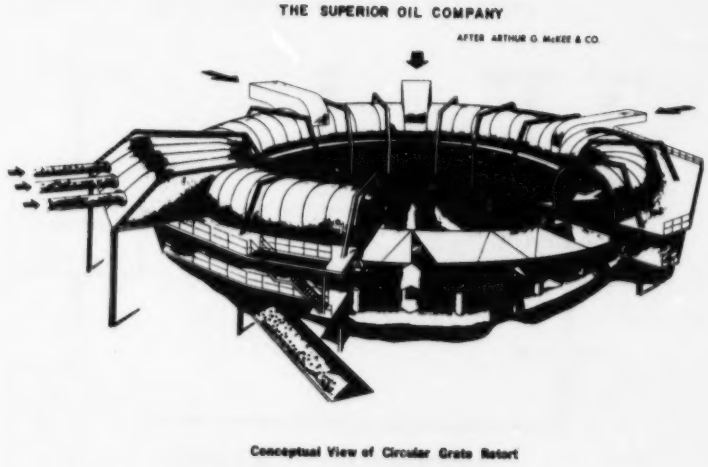

Figure 5. Conceptual View of Circular Grate Retort

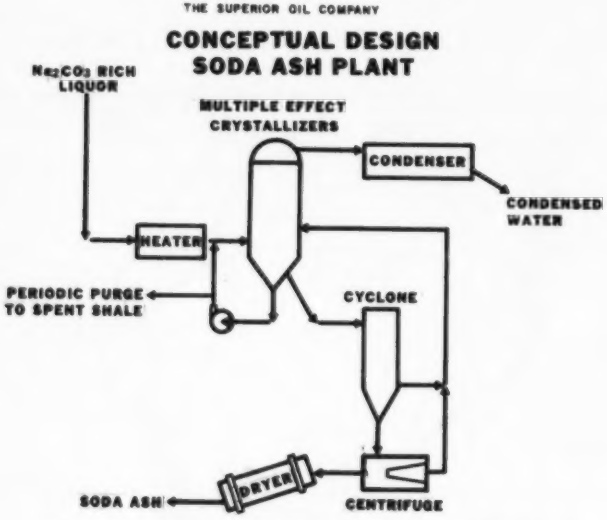

Figure 6. Conceptual Design Soda Ash Plant

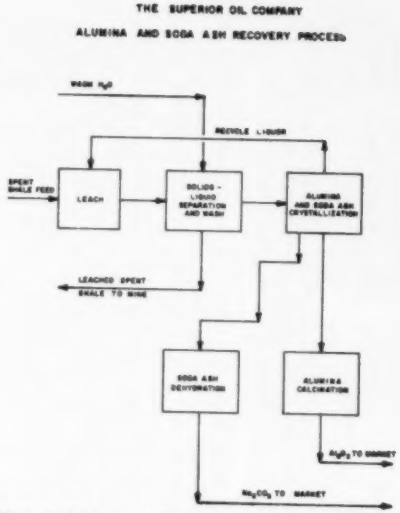

Figure 6-A. Alumina and Soda Ash Recovery Process

TOSCO, MIKE SPENCE

TOSCO Corporation has an active oil shale project in Utah and is also a participant in the Colony Development Operation project in Colorado, which was previously described by Les Ludlam. In addition, TOSCO has other oil shale land holdings in Colorado, including both patented and unpatented lands. The Sand Wash Project, located in Uintah County, Utah, is in the early stages of development by TOSCO Corporation. The project is located south of Vernal, approximately fifteen miles west of federal lease tracts U-a and U-b. TOSCO acquired some 20,000 acres of state leases, located in noncontiguous blocks, in the early 1970s. Thereafter the five major lease tracts, which comprise some 14,000 acres, were unitized by action of the Utah State Land Board and the Board of Oil, Gas and Mining. The unit is called Sand Wash Unit and TOSCO operates the unit under unit agreement and a cooperative plan of development approved by the State of Utah.

Following approval of the unit agreement TOSCO filed a mining plan with the State Board of Gas and Mining to conduct environmental work and resource evaluation, and field studies have been conducted in both those areas during the past several years. In 1978 TOSCO filed an amendment for their plan calling for the sinking of an experimental mine shaft to be followed by experimental mining. The amendment was approved by the state in late 1978 along with the air quality permits that were required to carry out the project. Under the unit agreement, Tosco is required to spend some $8 million in development costs over an eight year period in $2 million increments every two years. The first $2 million increment was completed in December of 1978.

Under the plan, which has just been approved, TOSCO will start site preparation and field work on the experimental mine shaft in 1979. Shaft drilling will begin in late 1979 or early 1980 and will take a period of eighteen months to two years to complete. Shaft sinking will be followed by a period of two to three years experimental mining.

At this point TOSCO regards commercial development of the Sand Wash Project as a long range project. However, study of plant design, water, transportation, socioeconomics, and all the various other matters that go into commercial project planning are being examined.

TOSCO maintains a field office in Vernal, which has been staffed by three or four people over the last several years. Once the mining development program commences that staff will increase.

UNION OIL, ALLEN RANDLE

Union Oil Company of California became interested in oil shale more than fifty years ago, when it started acquiring oil shale lands. The principal portion of these holdings are 30,000 acres north of Grand Valley, Colorado. Twenty thousand of these acres are oil shale bearing. Water rights were obtained along with the lands so that we now have sufficient water rights to supply a commercial plant.

Union has conducted continuing research on oil shale retorting technology over the years. A highlight occurred between 1954 and 1958 when Union operated a semiworks plant located on its Colorado property. This plant demonstrated Union's "Retort A" process.

Since 1974 Union has been studying the best method to commercialize its technology. A new semiworks plant was considered and found to be too costly to be justified by the knowledge to be gained. A full-scale 50 MB/D plant, consisting of six to eight retorts, was also studied but was found to be very costly and premature for the current state of the technology.

An experimental plant consisting of a single commercial-sized retort was selected as the next logical step in the technical development. A single commercial retort represents the minimum size needed to obtain necessary information, such as determination of operating limits of a full-size retort, development of process improvements that can only be accomplished in a large facility, gathering of economic data for future commerical development, and development of techniques to secure the best attainable control of environmental impacts.

When environmental issues are resolved and economic conditions are improved enough to justify the expenditure, Union is prepared to start construction of its Long Ridge Experimental Shale Oil Project.

Although other incentives would be useful, we at Union firmly believe that a $3/bbl tax credit is a proper economic incentive to assure construction of the first experimental facility. This incentive has the following advantages:

1. It is production oriented.
2. The developer assumes the technological risk.
3. It does not require government selection of one process but allows construction of a number of pioneer plants using various technologies.

4. There is no cost to the government until and unless production begins.

5. The cost to government in lost income tax revenues is offset by lower imports and improved balance of payments.

6. This incentive is simple and inexpensive to administer.

Application has been made for the following permits:

1. Prevention of significant deterioration from the Environmental Protection Agency

2. Emission permit from the Colorado Air Pollution Control Division

3. Regular operations permit from the Colorado Mined Land Reclamation Board

4. Special and conditional use permits from Garfield County

The use permits from Garfield County were granted in November 1979. The others are under review by the agencies.

We believe that we can operate a shale oil plant that will comply with all existing environmental regulations. However there are several new laws that are currently being translated into regulations. These regulations must be worded to achieve the legislative intent of these new laws and without placing so great a burden upon the oil shale industry that it is prevented from developing.

Union believes that the next step in oil snale commercialization is construction of one or more single commercial retorts using various technologies. Union has the resources to do this and is ready to proceed when a proper economic climate is provided and when all permits are obtained.

Question: (Sam Farlane, DOE-Denver) What would you do if you built the best retort and failed because of technological and engineering reasons?

Answer: Frankly, I have not considered that possibility.

Question: (Arnold Pelofsky, SAI) What is your cost of the single modular program?

Answer: In the neighborhood of $100 to $128 million.

Question: (Pelofsky, SAI) If it were close to a billion dollars, would Union still feel the same about the $3.00 tax credit?

Answer: I really cannot speak to that. I do not even know if it has been evaluated in that light. Our feeling is that this commercial-size retort and that the experimental program at that level is going to allow us to make improvements in the technology that are going to improve its economics.

Question: (Les McMillion, EPA-Las Vegas) What is the estimated yield of the single unit?

Answer: Approximately nine thousand barrels per day.

Question: Are you super hygrading? What is the yield of your oil shale?

Answer: Forty-two gallons per ton.

Question: Is that typical of your reserve?

Answer: No our reserve varies quite a bit. The seam is about 120 feet thick.

Question: Is it economically viable below the forty-two gallon per ton? If it were thirty gallons per ton, would the $3.00 help you very much? Would it make it economically viable?

Answer: Probably not.

Dr. Coffer next presented Rees Madsen of White River who gave his review of their project using a series of slides for illustration.

WHITE RIVER OIL SHALE, REES C. MADSEN, ENVIRONMENTAL COORDINATOR

The White River Shale Project is a joint venture of three oil companies, Sohio Natural Resources Company, Phillips Petroleum Company, and Sunoco Energy Development Company. These three companies established the White River Shale Project for the sole purpose of developing the two federal orototype oil shale program lease tracts in Utah (U-a/U-b).

These tracts are located about fifty miles from Vernal, Utah, each one of them is a 5,120 acre tract, 10,240 acres in total size, and are located in northeastern Utah (Figure 7).

The purposes of the federal prototype oil shale leasing program have been discussed and the need to proceed with the concept has been explained. We still feel that the idea of demonstrating oil shale technology in the field and answering the questions about economics and environmental concerns and technical

constraint is important. We still subscribe to the goals and to the concepts of the prototype program.

White River Shale Project (WRSP) is not now a company. It is a joint venture responsible to the three owner companies. We are an operating entity in essence, responsible solely for the development of tracts U-a and U-b. Over the last several years, starting in 1974 when WRSP was formed, we have used contractor services to carry out our various activities (Figure 8). One of the things that we have been doing since 1974 is environmental type work. One of the things that has been accomplished is the "Detailed Development Plan" that proposed a program for providing a 100,000 barrel per day facility on U-a and U-b. We have done other things since the submission of that "Detailed Development Plan" in June 1976. The geologic exploration program is typical of the program that was carried out on the other federal prototype lease tracts. There were over twenty holes drilled, some of them were for core samples and some of them were for hydrologic studies. Some serviced a dual purpose in defining the geology and hydrology of the area. Our environmental studies were dictated by the terms of our leases on U-a and U-b and involved a two-year program to review all aspects of the environment (Figure 9).

EPA people and DOE people as well as industry are familiar with the trials and tribulations of the baseline program. Our cost to date for the on-going environmental program is almost $8 million and that combined with the $6 million engineering plan brings us up to a pretty hefty investment to date. If you add in the $72 million that has been paid to the federal government as the first three lease bonus payments, you can see our owner companies have invested over $85 million in the program to date.

Some of the things that we developed as far as engineering studies are concerned are technology evaluations and economic evaluations. These were all included in the preparation of the "Detailed Development Plan." It describes in detail what we will be doing in regard to developing the properties.

The two-year baseline program was an effort to develop an expertise insofar as how these things should be done in future leasing programs by the federal government. I am sure that we would never do them again the way that we did, knowing what we know now. These programs should not be taken as precedents for future leases or future monitoring programs--we should be able to learn from what we did and go forward. I have seen occasions where the baseline program for the federal leases has been used as models and frameworks for discussing baseline programs for other programs. I think we need to take a close look at that before we do go in that direction.

As far as the "Detailed Development Plan" was concerned at the time we submitted it, it was clear to us and the owner companies that modular development was required to prove the tecnnology and also to create a better basis for developing economic evaluations and to answer the environmental questions that would allow us to plan for a commercial facility. We also identified several problems that needed to be addressed such as air quality, which I will describe in a little more detail later, national energy policy, and some of the lease provisions under the prototype program.

The "Detailed Development Plan" is described in the plans for our operation. We are talking about a deep room and pillar operation about 1,000 feet below the surface of the ground. In our original "Detailed Development Plan" our approach was a surface retorting technology. We are now investigating the application of an in situ technology as a secondary recovery process. But the concept we are still working on as a primary concept is room and pillar mining, bringing the material to the surface and retorting it. Since the submission of the "Detailed Development Plan" we have continued exploration studies and continued our evaluation of retorts.

It might be good to point out at this time that we are not in the technology development business. The White River Shale Project's expressed goal is to use demonstrated technology in the development of our properties. We have done some tests where we have processed Utah shale through both the Paraho process and the Union process. We have run shale oil combustion tests and continue to do environmental studies, especially in areas of concern like ozone levels that have been measured as being quite high, and in regard to revegetation research, which has not been completely defined in the Utah area. We still consider shale oil to be the closest synthetic fuel to commercialization as far as liquids are concerned. We still feel that this is correct and have not seen anything to change our minds. To date our three companies are committed to the eventual development of the oil shale resources.

Water is a prime ingredient in any kind of processing. We are looking to the White River dam in the State of Utah to satisfy our water requirements. This dam has been approved and accepted by the State of Utah. In fact they are the ones who will construct it. Bond issues have been passed in the state so that the dam will be financed by the state. We expect this to be successfully constructed and to provide water not only for our operation but also for other oil shale developers in the State of Utah.

The White River Shale Project is presently delayed from moving forward in the field of development activities. The original delay was environmental, one having to do with an ozone level that was recorded near our site and was above the national ambient air quality standards. That was started in November of 1976. Before that one-year suspension ended, we ran into problems concerning the title to the property, and we are presently waiting for litigation to be concluded that will provide us a way of knowing that we do have a lease on the property and we can plan for development for the future. Economics and technology development needs also bear on our inability to go forward at this time. But we are securing our position and working toward resolution of these problems. One of the things that we are here to talk about is how we get through some of the regulatory problems--get down to the bottom where we can mine some oil shale and produce some shale oil and do that in an environmentally acceptable manner. This group has a real role to play in this.

Let's look at some environmental factors of concern to us. I know the EPA is not responsible for all of these factors or problems. Neither is the Department of Energy, but this is what we as developers see when we look out at the regulatory picture. We see things like dealing with wilderness classifications where these areas might become "Class I" prevention of significant air quality degradation areas that might be located fairly close to areas of development. We see air quality regulations, both existing and proposed, that increase concerns over our ability to meet such stringent requirements. We see the classification of areas like Dinosaur National Monument as "Class I" that will provide questionable environmental protection, but have a potential adverse effect upon the development of oil shale.

We see problems in getting environmental impact statements prepared. The White River Dam is ready to be constructed (Figure 10). The money is ready through bonds, yet we are having difficulty in getting the environmental impact statement procedures started. We worry about wild and scenic river classifications, toxic substance control regulations, resource recovery and conservation act regulations having to do with hazardous substances, and mine land reclamation. We are watching very closely the efforts to decide whether or not to put shale mining under the auspices of the Coal Surface Mining Reclamation Act. Also of concern in our planning are existing and evolving water quality standards, endangered plant and animal regulations and, of course, efforts to solve the socioeconomic problems associated with development. I think the overall point here is these moving targets. We are not in a position to clearly know what all the rules are and what all the regulations are that we have to face. If we can gain a better appreciation of each others' problems as a result of today's meeting, it certainly would be a help.

Some of the steps that we see as important and are progressing on are:

1. Reduce the number of permitting agencies.

2. Complete the "Handbook" that we understand EPA is working on that will be available to those of us who are working in the permit area. This will help guide us and save us from making false steps and false starts. It should help us pull together the interpretations and administrative ideas as well as regulations that bear on getting permits for our operation.

3. Revise the Ozone standard.

4. Resolve how processed shale fits in with the Resource Conservation and Recovery Act.

5. Provide a grandfather clause, or the freezing of compliance standards, so that when we get a permit we know in that permit what kind of standards and what kind of performances are required. This should allow us to be relieved from compliance with some of the requirements that will evolve in the future and certain kinds of regulatory changes.

In summary, all three companies have a major commitment to oil shale development. Money expended to date represents $85 million. We are also still looking at bonus payments under our leases of $48 million. We have conducted extensive tests. Utah is supportive of the oil shale business. We believe that a modular demonstration program is a must whether it is done by us or by those who are developing technology at other locations.

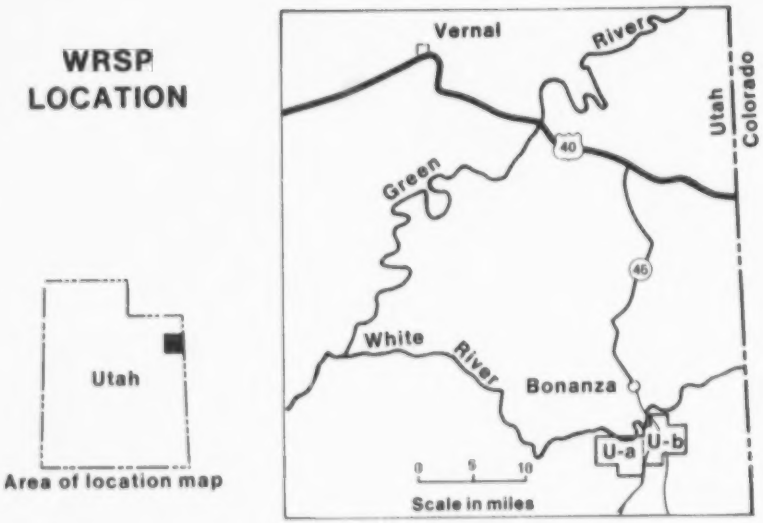

Figure 7. WRSP Location

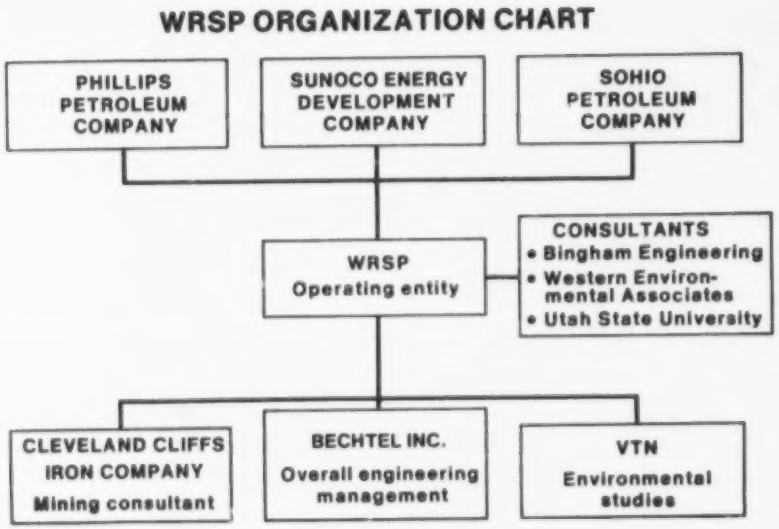

Figure 8. WRSP Organization Chart

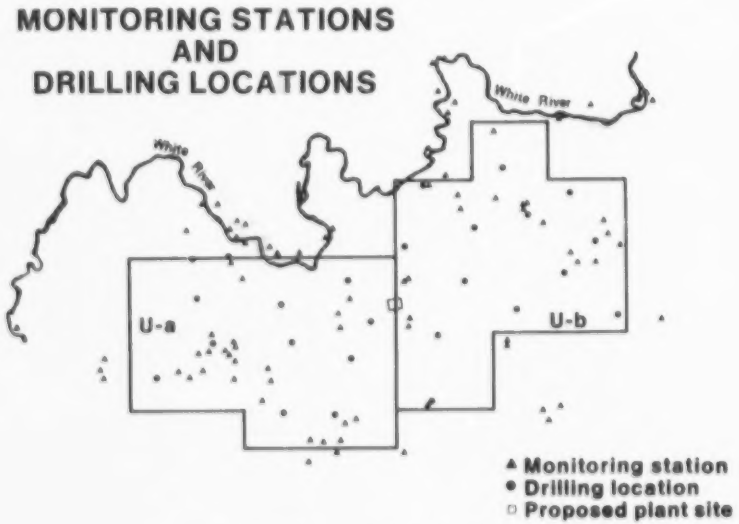

Figure 9. Monitoring Stations and Drilling Locations

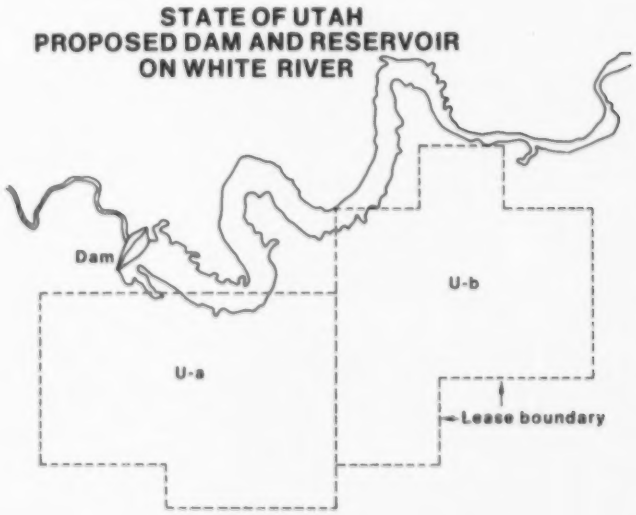

Figure 10. State of Utah Proposed Dam and Reservoir on White River

DOE-LARAMIE ENERGY TECHNOLOGY CENTER, ANDY DECORA, DIRECTOR

When Deputy Undersecretary Gouraud was here and talked to many of you about the constraints of the oil industry last April, many of you pointed out that the permit process was one which was a very large roadblock. The deputy undersecretary heard you at that time and started a study funded through our office and contracted out to Science Applications, Incorporated, to try to unravel a lot of that process. The first phase of that study has been completed, and we can entertain through my office requests from many of you who are interested in hearing about that. We will send the Phase I report to you to indicate some of the level of work that was done there. I think the deputy undersecretary should be commended from the standpoint of attacking this very considerable area insofar as restraints on development are concerned. Phase I is done, and we are proceeding with other elements of that. The two investigators are Dr. Harry McCarthy and Phil Aramis of Science Applications.

Many of you have heard of the cessation of Talley Industries fracturing experiments in Southwestern Wyoming. You will recall that under the department's program opportunity, known as #2, that there were five in situ type cooperative concerns with industry shared by the DOE; one of those was with Occidental, one with Equity, one with Geokinetics, one with Dow, and one was with Talley Energy in Southwestern Wyoming. All five of those particular operations dealt with one or another category of in situ experimentation and had various formulas insofar as either cost sharing or the total commitment on the part of the government in the funding of the project.

The Talley contract was one which was 100% funded by the federal government and was operating first in the fracturing phase and second, depending upon the success of that phase, a retorting phase in a forty foot zone of about twenty-five gallon per ton shale in southwestern Wyoming. The experiment was something over $1 million, I think $1.3 million for that first phase, and did have an evaluation step that was required by the contract at the time of the completion of the evaluation of the fracturing of the experiment.

Talley, in about late summer 1978, detonated about 60,000 pounds of their explosive in the 40 foot zone of shale about 200 feet below the surface. I was present witnessing that shot, and it was quite a bang! Following the detonation an extensive period of evaluation went on--the site was very highly instrumented by Sandia Laboratories and other contracted laboratories to Talley, the subcontractor under the basic contract. About the first week in December some thirty technical people representing National Laboratories, the Laramie Energy Technology Center, and a couple of other contractors were gathered together in Laramie, at which time about six technologists from Talley gave a very extensive project review on the analysis of down hole camera shots of the fractured zone. The technologists pretty much agreed that many of the sought after results were not in fact obtained from the experiment. While it did yield much data, the expected extent of fracturing had not been achieved and therefore, that panel of technologists rendered a recommendation to program people in DOE in Washington that the first phase of that contract be considered complete, and that the retorting phase not be done for that particular location.

One chief factor that was entered into that judgment was the fact that simultaneously the Laramie Energy Technology Center had been working on its site 12 for a similar kind of experiment. We were looking to the actual ignition and the retorting of that site rather than to run two at the same time. We believe we had a better level of success in site 12 than obtained in the Talley Experiment, and, therefore, site 12 should go into retorting phase. So we are now awaiting the results from Rock Springs site 12. That site was ignited last month, and with some difficulty the ignition is being sustained. Some of the pressures and flows are not exactly what is wanted at this particular time. Those of you in this field know that the true in situ technology is by far the most highly speculative and also the one which we know the least about. We know we generally cannot get the amount of permeability that we are actually looking for.

So that is where we are at this present time. The first phase of the Talley contract, which was simply one of fracturing the formation with explosive, was deemed complete. The exact results as were required by the contract were not really met--through no fault of the companies--just the permeability and the extent of the fracturing were not as good as we needed.

One final comment--you all know that basis of work that the LETC has been performing under the Bureau of Mines, under ERDA, and then the DOE. Essentially we have the responsibility of the assistant secretary for energy technology for basic development and assembly of industry and government data for analysis across the board of the oil shale technology

development. We have some 166 different task elements that are represented by work done both at Laramie and among the National Laboratories and among industry. Those things cover such things as retort modeling, environmental support, control technology work, process diagnostic evaluation, and other similar programs. The financial plan for all of that this present year is about $26 million.

Question: Would you care to speculate on what the plan is going to be for next year?

Answer: It is public and published, but we do not have our copy.

COLORADO DEPT. OF NATURAL RESOURCES, ROBERT SIEK, DEPUTY DIRECTOR

I am the deputy for the Department of Natural Resources and serve also as the director of the Office of Mineral Resource Development. Colorado is anticipating increased activity in the development of its natural resources. If the state is to intelligently manage this development, it will be necessary to have methods in place to provide a thorough, comprehensive and efficient review of proposals. Oil shale development is potentially one of the most difficult to deal with due to the uncertain nature of the technology to be used.

To address the oil shale issue, Colorado with support from DOE is attempting to prepare a trial for modular development in commercialization when it occurs. Let me explain briefly some of the current projects we have under way in Colorado. The program in the area of air and water pollution is under the jurisdiction of the Colorado Department of Health, and our working relationship is close and we intend to coordinate as much as possible. We have heard a lot today of permits, and Colorado is now in the process of trying to address the permit situation. We are as aware as anyone of the confusion and are trying to take steps with the DOE to alleviate the problem as much as we can--especially as they appear from all levels of government, not just state government.

We have several programs going in Colorado anticipating oil shale development. We have asked the Colorado Energy Research Institute to develop criteria for us to judge the relative success of oil shale technology. They are working on that now, they have a contract with Booz-Allen and that will be a continual program for the next few years. DOE is under contract to some of the national labs and the University of Colorado to establish a task force to study some of the environmental impacts from modified in situ operations. We are also working with the U.S. Bureau of Mines and trying to determine the explosive nature of oil shale dust. We are working on a joint review process. We have a demonstration project that we are working on, the Mount Emmons project that Amex has in Colorado, which is an extensive operation. Amex is really a guinea pig to assist Colorado to develop a joint review process involving the three levels of government involved with reviewing large major energy and mineral resource development for the state. The government reviews of energy and mineral resource development projects are increasingly complex technically, legally, socially, economically, and politically.

Industry complaints about government regulation and lack of coordination have become more and more critical. Local citizen groups opposing and supporting various projects are more frequently formed to address specific projects. General public concern with government regulation, spending, and taxation have become major social and political issues. It seems that almost every energy and mineral development project proposed in Colorado is encumbered with conflict and controversy, which eventually create delays in decision-making processes and increased costs.

As Colorado experiences accelerated growth in energy and mineral development, it is becoming increasingly apparent that some mechanism is needed to better coordinate governmental reviews to enhance public participation, to minimize unnecessary conflicts, and to provide industry with greater opportunities to become involved with government and the public as early as possible in project planning. Our project in Colorado is an attempt to provide such a mechanism.

A joint review process as we currently view it, is an interjurisdictional review process that coordinates decision-making processes between the three levels of government, provides the public and special interest groups with additional opportunities to become involved in all phases of project planning and review. It provides informal forums in which government, industry, the public, and special interest groups have the opportunity to discuss issues and concerns. It promotes conflict resolutions through cooperation and realistic compromise.

Many people have asked, "Why do we need the review process?" We have identified at least three broad problem areas that point out the need. First, the heightened national concern for environmental protection as a result of proliferation of environmental and land use laws and regulations at all levels of government. Most of these laws and regulations were framed incrementally to respond to specific needs. Minimal attention was placed on the relationships of these controls.

To complicate matters, the number of enforcement agencies has also increased. Many agencies, although functionally related, are

organizationally separate. As a consequence of regulatory proliferation and agency fragmentation, regulatory requirements within and between levels of government frequently overlap, conflict, and duplicate one another. Decision-making actions of enforcing agencies are often redundant. The proponent is forced to develop several different sets of information addressing the same topic for several different agencies. Interagency disputes concerning jurisdiction and authority arise, and they all contribute to decision-making delays, increased administrative costs, and inefficient use of time and resources.

Second, operational procedures and habits of project proponents also contribute to delays and conflicts in the review process. For numerous reasons, some imagined and some real, proponents are frequently reluctant to approach governmental agencies or seek public involvement during early stages of project planning. Consequently, lines of communication are not established. Agencies and the public are uninformed about project proposals. Public concerns are not heard during project planning when changes can be made with relative ease. Project proposals are misinterpreted; agency requirements are misunderstood. Then, as frequently happens, a proponent may spend large sums of money on various studies and reports, only to find when he seeks a required permit approval or review that his proposal, his supporting information, or the procedures followed are not acceptable to the agency or the public. Thus, the proponent is faced with the inevitable choice of litigation, spending additional monies, and absorbing the accompanying costs of delay, or abandoning his project.

Third, public interest in the effects of development on quality of life and the environment has steadily increased in recent years. Grass roots citizen organizations, organized to support or oppose specific projects, are becoming a popular and effective tool to influence public and private decision-making. Citizens seem to be clamoring for more control over governmental processes and more influence over public and private decision-making. However, ongoing public access to project planning and review does not improve significantly.

Traditionally, public involvement has been limited to public comment period, protest filing, public hearings, and litigation. All of these techniques usually involve negative actions and adversary conflicts and generally occur after project planning is complete or well on its way. Consequently, many projects move smoothly forward until they reach the public comment and public hearing stage. Then, because of misunderstanding, lack of information, planned actions, and other reasons, protests about the project are entered into an agency's record, often creating delays in the decision-making process. While many such delays are warranted, some are not necessary.

Most conflicts and delays can be avoided or minimized by providing the public early in the review process with opportunities to express concerns, discuss issues, provide creative criticism, influence industry and government thinking, and generally protect their interests. Such opportunities could result in greater public and special interest group understanding and acceptance of projects, better planned and more carefully developed projects, increased protection of the environment, and generally more beneficial projects.

To insure that our project does not stray from the original intent and to insure that we address each problem area, we have defined ten project goals. They may appear to be somewhat idealistic, but if one stops to think about them they are ideals that we should be striving for. They are needed improvements in our governmental system.

1. To coordinate the environmental and land use decision-making process between the three levels of government
2. To encourage an attitude and create an atmosphere for cooperation and greater understanding between industry, government, and the public and special interest groups
3. To provide a rational, systematic alternative to the existing fragmented governmental processes
4. To provide a procedural manual to be used by the state when conducting a format review of a major energy and mineral resource and development project
5. To formulate a process that is more understandable, predictable and internally consistent without disturbing established lines of authority and power
6. To improve intergovernmental cooperation
7. To enhance and improve participation in governmental decision-making
8. To minimize conflicts, delays, and associated costs
9. To demonstrate the viability of a joint review process
10. To identify problems requiring legislative or administrative attention

Initial consideration of the major problem areas and project goals have led us to the conclusion that a joint review process must be

comprised of at least three major components. First, the permit, approval, and review requirements enforced by all levels of government should be coordinated. This task involves the monumental job of reviewing all federal, state, and local permit, approval, and review requirements to determine conflicts, duplications, and similarities. Fortunately, the Department of Energy recently completed a study called Permission I, which includes summaries of most of the regulatory requirements we will need. A pert chart will be created that arranges all permit, approval, and review processes into a logical sequence, utilizing similarities and duplications and minimizing conflicts.

Second, informal and formal mechanisms must be formulated to provide the public with increased access in the governmental decision-making processes and greater opportunities to affect industry planning. Alternative public participation techniques will be discussed and preferred techniques identified. Third, joint review procedures are imperative. They will provide decision-makers with step-by-step guidance in implementing the process. These procedures will integrate into one system, the public participation process, the federal, state, and local permit, approval and review processes, operational guidelines, and other techniques developed to accomplish project goals.

Numerous specific issues will be analyzed and evaluated in developing the process. These issues include the coordination and consolidation of application forms, the role of informal public conferences in reviewing the projects, relationship of the environmental impact statement process to a coordinated permit system, conducting a master hearing involving numerous agencies to establish a factual record, selection of a hearing site, establishment of time limits on agency decision-making, and the effect of such process on decision-making criteria.

We have no preconceived notion about any of these issues and recognize the potential importance of each. We will be analyzing and evaluating each issue to determine which of them may be addressed in the process and how they might be addressed. Based on these analyses and evaluations we will select viable mechanisms to be included in the process.

What have we accomplished thus far? In brief, we have hired a staff, developed a work plan outlining the study components and methodologies, and time lines have been prepared. We have formed a Technical Resource Committee of individuals with substantial experience and expertise in addressing interrelationships in environmental, industry, governmental, and public concerns and conflicts associated with major energy and mineral development projects. We have and maintain a public interest mailing list. We are progressing on schedule through the work plan. Currently we are involved in a literature review and are conducting interviews with people on our mailing list.

I would like to note that the time is ripe for government to begin to develop sophisticated methods that encourage competing interests to work together cooperatively for common solutions to conflict and disagreement. We no longer live in an age in which the traditional power interests always get their way. Government should not be allowed to do its job secluded from the public. Wasting time, money, and resources is no longer acceptable or affordable. Coloradoans seem to demand leadership that will simplify our lives without sacrificing quality. It is my opinion that our project is a giant step in the right direction. We would like to solicit your comment and help as we go along in preparing this joint review process for energy and mineral development in Colorado.

Question: Are you and DOE working on a project together?

Answer: We are working with DOE to coordinate reviews with local, state, and federal government.

Question: How long before the joint review process will be available?

Answer: There will be a manual that will lay down the guidelines of how a joint review process should proceed. It will be available to those projects of such magnitude as to qualify for it. At that time industry will have the option of being a part of the joint review process.

Question: When will this be completed?

Answer: November, 1979.

ENVIRONMENTAL ADVISORY PANEL,
HENRY O. ASH, EXECUTIVE DIRECTOR

The Environmental Advisory Panel operates under the Federal Advisory Committee Act, which provides for a two-year charter period and review at the end of each two-year period. It is technically terminated. We went through about a six-month period awaiting a decision on its reestablishment. An affirmative decision was made last August, and we had anticipated that operations would soon begin, but we are not operational yet. We are officially reestablished, and we are awaiting the completion of the roster of the members. The remaining members to be named are a couple of federal members and four public members to be named by the Secretary of Interior. There has been a change in the panel's composition of the new charter in that it now provides for two industry members, whereas the old charter provided for no industry

membership on the panel. We expect these members to be named very shortly, and in the next few weeks we should be reconstituted and fully operational. We will plan a meeting within the next two months. The panel is an intergovernmental agency. The members are drawn from bureaus and offices of the Department of the Interior and other major federal agencies, state government, and county government and with a number of public nongovernmental members. Total membership under the new charter will be twenty-six.

Dr. Coffer introduced the next speaker, Alden Christianson, director of the EPA laboratory in Cincinnati. He presented the following paper.

EPA OIL SHALE RESEARCH PROGRAM, ALDEN G. CHRISTIANSON

Introduction

The U.S. Environmental Protection Agency (EPA) is mandated, under numerous legislative authorities, to maintain and enhance environmental quality and to protect human health and welfare. In support of this mission, the agency's Office of Research and Development (ORD) conducts a comprehensive and integrated research program to provide the following:

1. The scientific technical data base for reasonable standards and regulations;
2. Standardized methods for measurements and to assure quality control in programs that assess environmental quality, implement regulations, and enforce standards;
3. Cost-effective pollution control technology and incentives for acceptance of environmentally sound options; and
4. Scientific, technical, socioeconomic, and institutional methodologies needed to judge and balance environmental management options against competing needs.

Energy R & D

Emphasis on energy-related research has increased within EPA over the past four or five years--basically for a couple of interrelated reasons: First, our ever-changing energy dilemma has focused more attention on fuel supplies and energy conversion and has resulted in increased efforts to utilize coal and to develop alternate supplies of fuel and energy. Secondly, federal government emphasis on energy research and development in 1973-1974 recognized the environmental implications of accelerated energy development. A coordinated, Interagency Energy/ Environment R&D Program was established and funded through special appropriation to EPA, with EPA's Office of Energy, Minerals and Industry being charged with the responsibility for implementing the Interagency Program.

Two CEQ (Council on Environmental Quality) task force reports established the basis for the Interagency R&D Program, covering (1) Health and Environmental Effects of Energy Use and (2) Environmental Control Technology for Energy Systems. These categories are maintained and subdivided into various components so that proper management can be applied in terms of funding and balance. Areas addressed on the effects side of the program include: pollutant characterization, measurement, and monitoring; pollutant transport, health effects; ecological effects; and integrated assessment. Control technology R&D addresses: resource extraction; coal cleaning; flue gas cleaning; direct combustion; synthetic fuels (including oil shale); nuclear fuel cycle; thermal control; improved efficiency; and advanced systems.

Approximately 60% of the funding authorized for the Interagency Energy/Environment R&D Program has been apportioned to EPA; about 40% has been distributed among over a dozen other federal agencies for relevant environmental research.

In terms of fuel types being addressed, approximately 50 to 60% of funding has been devoted to coal-related R&D; approximately 25 to 30% to oil, gas, and multi-fuel R&D; and the remainder divided among the less conventional fuels or technologies. Oil shale R&D has received on the order of 2 to 4% of the program's funds. In dollar terms, this has amounted to about $3 to $4 million per year being directed to oil shale research and development.

For those interested in the Interagency Energy/Environment Program, there is a "Status Report" and "Who's Who" directory available.

Oil Shale R&D

Within EPA, research related directly to oil shale development is conducted through programs of over one-half of the fifteen mission-oriented research laboratories. In addition, the Region VIII Office here in Denver, conducts some activities that are closely related to research.

The mission orientation of the EPA Research Laboratories means that various categories of work related to oil shale development are spread throughout different laboratories and locations. For example, research on measurement and monitoring, environmental transport processes, ecological effects, health effects, and control technology is carried out by different laboratories that

focus on those respective missions. To assure that all oil shale research would be coordinated within EPA, an Oil Shale Work Group was formed in 1975 to maintain an integrated overall program. The Work Group is comprised of individuals from EPA Laboratories, the Region VIII Office, and EPA's regulatory offices. All representatives are personally involved in research or other EPA Program responsibilities dealing with oil shale. Many of these individuals are present at this meeting.

Activities in the measurement and monitoring program include development of instrumentation, methodology, and quality assurance procedures to monitor conditions or identify pollutants. In addition, field monitoring programs are conducted to establish baseline or other conditions and detect changes.

Air monitoring projects have been conducted primarily by Region VIII. They have included efforts to correlate National Weather Station data with that taken at lease tracts. This was to determine the representativeness of meteorological data from the standard, long-term monitoring stations, which might aid in interpretation of weather conditions at lease tracts.

In another effort, upper air data was collected at tracts C-b and U-a/U-b to generate stability/wind rise information for use in assessing pollutant dispersal and fate, and the impact on air quality. Another project has supported the installation and operation of air monitoring sites in Western Colorado in order to collect baseline air quality data prior to major expansion of energy development activities.

The Environmental Monitoring and Support Laboratory at Las Vegas is assessing the impacts of oil shale extraction and coal strip mining on ground water in the Uintah and Piceance basins through a comprehensive monitoring program. The Las Vegas Laboratory also supports both air and water monitoring networks throughout the western U.S. to monitor and assess the impact of energy development. Outside of the EPA, the USGS is also involved in conducting water monitoring projects that will provide information relative to energy development. Funding for some of this related work is provided by pass-through funds from the Interagency Energy/Environment R&D Program managed by the EPA.

Development of instruments and methods to identify components of energy-related wastes and effluents is pursued by the Environmental Research Laboratory in Athens, Georgia. This work is generic in that it will apply to a broad list of energy sources in enhancing our ability to accurately describe the chemical characteristics of process streams and residuals. Outside of the EPA, the National Bureau of Standards is also conducting supportive work in this area under the coordinated, Interagency Program.

To better predict environmental transport processes, the Environmental Research Laboratory in Ada, Oklahoma, is attempting to relate chemical changes in ground water to the characteristics of overburden and the changes that occur there due to mining, gasification, and retorting. By understanding the transport mechanisms more clearly, we hope to be able to predict environmental impacts more accurately and avoid damaging consequences.

In terms of effects of research, EPA's Environmental Research Laboratory in Duluth, Minnesota, is involved in a study assessing toxic effects on aquatic ecosystems from coal and shale oil development. This effect involved chemical and ecological baseline studies of waters in the Piceance Creek basin and bioassay characterization of potential discharges to receiving waters.

In the category of Health Effects, research is being conducted by EPA Laboratories as well as many other agencies concerned with the impacts of energy development upon human health. Since most of this work applies broadly to energy systems, as well as oil shale, extensive interaction is maintained between research groups.

The Health Effects Research Laboratories at Research Triangle Park, North Carolina, and Cincinnati, Ohio, are assessing the health effects of exposures to air and water pollutants resulting from energy technologies, including oil shale processing.

The Environmental Research Laboratory at Gulf Breeze, Florida, is studying the accumulation of potentially carcinogenic compounds in the marine food chain consumed by man.

Supportive health effects research, some funded through the Energy/Environment Program is conducted by various Department of Energy Laboratories (Oak Ridge, Livermore, Los Alamos, for example) and by NIOSH. The cooperative efforts cover a range of activities including maintaining a repository of materials for testing. However, most effort is devoted to effects, determinations, and related work, through whole animal, cellular, and other types of testing and studies.

The Industrial Environmental Research Laboratory in Cincinnati, Ohio, conducts control technology assessment and development for oil shale processing as well as other industries. To identify potential control needs, a comprehensive environmental assessment of oil shale development has been conducted. This study described recovery processes, characterized residuals, and identified technologies that might be useable for reducing unacceptable levels of pollutants.

In order to describe emissions more accurately and thoroughly, a field sampling and analysis study was conducted at the Paraho plant during its recent operation. Additional field studies for pollutant characterization are planned. When control needs are clearly delineated, field testing of small-scale treatment processes is planned to evaluate their control capability.

Fugitive dust studies have also been conducted at the Paraho operation to describe the nature, quantities, and specific sources of such emissions. Determinations were made in the vicinity of mining operations, haulage roads, crushing operations, and spent shale transfer points.

Numerous projects are under way that deal with safe disposal and control of adverse effects from spent shale disposal. Spent shales from Paraho, TOSCO, and USBM have been used in developing revegetation methods, in evaluating movement of salts and water on and through spent shales, and to describe leachate characteristics and control needs.

Additional research efforts are under way by the Cincinnati Laboratory alone, and with other agencies, to describe control procedures and technology for surface and groundwater impacts from various oil shale extraction, handling, and disposal activities.

The Industrial Environmental Research Lab in North Carolina is heavily involved in syn-fuel research and has addressed oil shale in some assessments. Also, within their programs on refineries, they have assessed emissions during refining of shale oil--during the recent Navy refining of Paraho oil.

A final category of research work by EPA which, in part, involves oil shale development is integrated assessment. These studies attempt to incorporate social, economic, and technical factors in analysis of likely energy development scenarios. One such study has addressed Western Energy Resource Development to identify major environmental concerns. Another project, conducted by USDA with pass-through funds, focuses on coal and oil shale development with respect to resource competition and use and the agricultural economic implications of such development.

Pollution Control Guidance

As mentioned earlier, a primary purpose of EPA research and pollution control development is to support the standards-setting function of the EPA. The research activities described earlier have been conducted in that vein and have led to a pretty good technical understanding of the developing oil shale industry and of the environmental problems that such development may pose.

I know you are aware that the environmental protection legislation applies to oil shale as well as other industrial operations. In total, compliance with existing or anticipated air, water, and solid waste requirements is no small or easy task.

Developers of new industries face a particularly difficult task since specific pollution control requirements are not and cannot be defined completely. It is a chicken and egg situation--we need to know what is possible and reasonable, but real world experience is needed in many cases to generate that knowledge. Alan Merson has addressed this very point earlier this morning--that some answers will not come until representative, prototype operations are underway.

Recognizing this situation, EPA is initiating an effort to provide early environmental guidance for oil shale development. A document entitled "Pollution Control Guidance for Oil Shale Development" is being prepared, based on technical input from researchers, working in conjunction with representatives of EPA's Program Offices and Region VIII. An outline has been passed out. The document will convey preliminary regulatory implications and technology-based environmental goals for the industry. This will be achieved by identifying regulatory mechanisms that are most likely to be applied, and by interpreting what these mechanisms may require in terms of identified ranges of possible discharge and emissions limitations. We realize this effort is a preliminary step in describing environmental requirements, but it should be helpful by providing direction to industry. In summary, we hope it will be helpful to be able to address pollution control requirements in a proper, staged approach, which will hopefully lead to a reasonable outcome based on facts--and no surprises.

Industry review and input to this "Guidance Document" will be solicited--in fact, I am soliciting your cooperation in this effort right now. A draft of the document will be available in late summer/early fall, and the EPA would like your evaluation of it. Where you have more up-to-date data or additional relevant data, we would appreciate your pointing this out and contributing data. By identifying and resolving environmental control problems early, we hope that oil shale development can proceed without delays caused by environmental impediments or confrontations.

As the status of knowledge and development increases, the document may be updated to reflect more definitive discharge limits and more demonstrated confidence in available control technologies. This effort will also be helpful in identifying research needs to fill technology gaps.

Comment: (Harry McCarthy, Science Application, Inc.) If anyone is interested in getting a copy of the Geothermal document, I will be happy to see to it that one is sent out.

Question: (H. Pforzheimer, Sohio) After all of the work you have done, have you run into any surprises?

Answer: We have not run into any real surprises.

Question: (Pforzheimer, Sohio) It was mentioned what had to be done in order to get the Alaskan pipeline built. It took an act of Congress to solve the environmental problem. Would there be any consideration to taking a similar approach with respect to the modular program for oil shale? The only way we are really going to get the data we want is to get in the field and try to operate these units with EPA and all other interested agencies monitoring the results. Granted we have some legal permit obligations that we have to satisfy, but if this is a real serious problem to the country to satisfy its own energy needs domestically then why all the quibble and war? Has any consideration been given to try to use that approach? We are getting pretty close to that point in time.

Answer: I do not believe consideration has been given to that approach. I do not know if the status of oil shale development is comparable to that of the pipeline.

Comment: Certainly to build modules and to do all the environmental work on them is the way to go. There are some questions that I think we can answer by doing some field studies in the absence of any oil shale facilities, such as more core holes, find out what water is available, more meteorological work, finding out the dispersion patterns in the Piceance Basin. Those are things we can do now. We need to have facilities and research data is needed from them. Dr. Chuck Prien with DRI is still on assignment with EPA and has asked when you build facilities to have some joint participation with EPA and in almost every instance the answer was yes. Projects coming out of Cincinnati are waste water treatment study and air pollution control study. These will be pilot type units that will go around and look at treatability. That sort of thing is what EPA is prepared to do and would like to go to the field with. The problem is we do not have any facilities to work on.

Comment: We have had access to the Paraho Development and the whole line that stems from that....I think it is very useful as a model. It covers everything from mining to retorting and on to refining. It gives us a chance to look at the whole line of development of products--mine dust and so on. We have retort and effluents. We have crude, upgraded crude, seven different products, all of which will go into Interagency systems approach, which at this time the participants are the U.S. Navy, EPA, DOE, and one or two private laboratories. That is the approach--from health aspects to mining retorting to transportation, occupational health, product safety, and product use, including the potential problems in combustion use. This is one example where the modular approach is very useful and should demonstrate that it can be carried out. The idea here is not to thwart the effects of oil shale but to get information as quickly as possible so we can proceed more rapidly.

Comment: It might be possible to assist in making progress in oil shale development to encourage more interagency communication. We are talking now about how beneficial it would be to have some modules to monitor and to get some of the real big answers from them. Yet, from the Department of the Interior, it was suggested that modules were premature at this point. I think we are not getting communication between the agencies that are making decisions which would permit modular development to go forward.

Comment: (Alden Christianson, EPA) I am sure that is true. There is never enough communication and especially with respect to oil shale development. We should really look at what kinds of mechanism for communication are there. The mechanism is more difficult to identify.

The "Guidance Document" will be one way, and we solicit your evaluation of it and input to it--there is probably a need for more communication than that.

Comment: (Pelofsky, SAI) One of the things that I have run into for a number of years, and this refers to the

"Guidance Document" as well as communications, is that everybody is talking, using different assumptions, and different bases. Perhaps industry could be helpful to you while this document is being prepared if you were to enumerate the assumptions. The same thing goes for interagency communication and industry communication. We saw an example of that today on the $3.00 tax credit.

Comment: (Christianson, EPA) We have decided with respect to the document, to put together the status and knowledge as we, within EPA, see it, (technical data and so forth), and incorporate it in the EPA rough draft and then ask industry for its comments.

Comment: (Pelofsky, SAI) But you see, by the time the document is ready to be published, if the basis and assumptions are not clear, it would be too late to review.

Comment: (Christianson, EPA) No, it will not be too late to review. It is basically to provide early guidance. It is going to be based on technical data and EPA's perspective of regulations, for example, how the Clean Air Act and Solid Waste Acts are going to be translated for the oil shale industry. It depends on what technology is available and the limits that need to be set for health and welfare protection. We do need to have access to facilities that are operating. We want to work cooperatively with you to assess control technology capabilities. If you have facilities available for that kind of thing, or the time is right for that kind of interaction, we would welcome your expression of that by contacting either me, or Terry Thoem, so that it could be evaluated. We would like to be aware of any opportunities for us to do some onsite work or cooperative work.

Terry Thoem from the EPA Region VIII Office was introduced, and he presented the following paper on the EPA regulatory program.

EPA-REGION VIII, DENVER, TERRY L. THOEM

Introduction

Enabling legislation during the 1970s in the environmental medium of air, water, solid waste, noise, and toxic substances has expanded the EPA regulatory jurisdiction and has created an increased need for research programs. EPA is often asked the question, "How large an oil shale industry can Colorado, Utah, and Wyoming support?" Is air quality a limiting constraint? Is it water quality or water availability? Is it socioeconomic considerations? Is it economics? Or is it technology? If you think I am going to answer those questions in this paper I am afraid I will have to disappoint you. Rather, I will describe to you the EPA regulatory activities and philosophy that bear upon the question. The topic could perhaps be labeled as describing everything about EPA that you never wanted to know but that you are forced to live with. I will discuss this topic of regulations in the framework, the approach toward regulations, and finally the suggested permit limits.

Framework

The general process of legislation/regulations is that the U.S. Congress establishes environmental legislation that provides a framework for state legislation and implementing federal and state regulations. In many instances EPA is faced with the task of interpreting that legislation. State legislation and regulations can be more stringent, but not less stringent, than federal requirements if a state is delegated responsibility for administering the program in a given media. The federal government retains an oversight reviewing role for those programs that are delegated to the states. State legislation, in general, parallels federal legislation in form and substance.

A comprehensive research program must provide a data base upon which EPA may fulfill its regulatory responsibilities. These regulatory activities serve to protect the environment while allowing the development and reasonable growth of an oil shale industry. Enabling legislation and implementing regulations in the form of the Clean Air Act Amendments of 1977 (P.L. 95-95), the Clean Water Amendments of 1977 (P.L. 95-217), the Safe Drinking Water Act of 1974 (P.L. 93-523), the Resource Conservation and Recovery Act of 1976 (P.L. 94-580), the Toxic Substances Control Act of 1976 (P.L. 94-469), and to a lesser extent the Noise Control Act of 1972 (P.L. 92-574) establish the regulatory framework through which EPA operates. Of course the National Environmental Policy Act of 1969 (P.L. 91-190) is also a significant piece of environmental legislation. Since other entities such as the respective state agencies and the Area Oil Shale Office also have regulatory jurisdiction in similar media, EPA-Region VIII has established a close working relationship with these organizations.

Under the Clean Air Act oil shale developers must 1) employ Best Available Control Technology (BACT), 2) insure that National Ambient Air Quality Standards (NAAQS) are not violated, 3) not cause Prevention of Significant Deterioration (PSD) ambient air quality

increments to be violated, 4) not significantly degrade visibility in mandatory Class I areas, and 5) perhaps obtain one year of baseline data prior to applying for a PSD permit to construct and operate. BACT has been defined in the form of allowable emissions limits for sulfur dioxide and particulate matter for two permitted facilities. Effective on March 1, 1978, BACT limits for nitrogen oxides, carbon monoxide, and hydrocarbons must also be specified in all permits. Source monitoring, ambient monitoring, recordkeeping, and reporting requirements are also part of the PSD permit.

The Clean Water Act contains requirements in sections 301 and 404 for potential permits for an oil shale developer. A National Pollutant Discharge Elimination System (NPDES) permit must be obtained under requirements of section 402 if water is discharged to a navigable stream. Specific effluent guidelines have not been promulgated for oil shale facilities. A Section 404 permit must be issued by the Army Corps of Engineers and concurred upon by EPA if any dredge and fill operations take place in a navigable stream. Section 303 of the act provides the mechanism for establishing water quality stream standards. Plans developed by various state water pollution control agencies must define water courses within the state as either effluent-limited or water quality-limited.

Underground injection control (UIC) regulations to be promulgated under the Safe Drinking Water Act will govern the injection or reinjection of any fluids. Permits will probably be required for in situ operations and for mine dewatering reinjection. The State of Colorado requires reinjection permits under existing regulations. Monitoring and mitigation measures to prevent the endangerment of the groundwater system will be requirements under these UIC regulations.

The Resource Conservation and Recovery Act (RCRA) governs the disposal of solid and hazardous wastes generated by an oil shale facility. Included in this category will be processed shale, spent catalysts, process sludge, and sewage wastes. Criteria for the identification of hazardous wastes were proposed by EPA in December 1978. Performance standards defining safe disposal practices for hazardous wastes were also the subject of a special mining waste study, which will be completed in February 1979. Permits requiring safe disposal of hazardous wastes will have to be obtained from EPA or a state by an oil shale developer.

Testing of effects, record keeping, reporting, and conditions for the manufacture and handling of toxic substances are being defined under the auspices of the Toxic Substances Control Act of 1976. An inventory of all commercially produced chemical compounds is now being compiled and will be published soon. If a substance is placed on the inventory it is "grandfathered" from the TSCA requirements. Shale oil and/or its refined products are slated to be on the inventory.

Manufacturers of new chemical substances must notify EPA ninety days prior to their manufacture and must also describe the proposed use, the amount produced, and by-products, disposal practices, and any test data related to the health and environmental effects potentially caused by the chemical's use. The manufacturer may be required by EPA to perform testing of a chemical's effects such as epidemiological, carcinogenic, mutagenic, environmental, etc. The EPA control of a chemical's use may take one of three forms--manufacture with no restrictions; a ban; manufacture with conditions placed on the handling and use of a chemical. EPA has promulgated regulations regarding one substance--PCBs. Production of PCBs is prohibited after January 1979. Noise and radiation legislation have little impact upon an oil shale industry.

The final piece of environmental legislation in which EPA participates is NEPA. EPA reviews Environmental Impact Statements (EIS) and in limited cases will write the EIS when a project involves a major federal action. EPA's roles as a reviewer is to comment on the environmental aspects of the project.

EPA's legislation as described above normally provides a permit process mechanism. Companies wishing to construct and operate an oil shale facility must receive a permit from EPA or the state permitting authority in order for the facility to be operated. A compilation of the permits required for an oil shale facility will be provided in the Pollution Control Guidance Document.

Precommercial Approach to Regulations

The approach toward regulating pilot-module oil shale facilities must insure compliance with existing standards, but more importantly, should emphasize characterization of residuals from an oil shale facility. Comprehensive emissions effluent and waste material monitoring should be performed by the company. Research programs designed to define the optimum control technology for a given pollutant for an oil shale industry should be conducted. Trade-offs among air pollution/water pollution/solid waste must be considered. The energy penalty, water consumption, and control must be defined. The comprehensive monitoring efforts should not be limited to only the "designated" pollutants, but should characterize all "suspect" pollutants.

Anotner concept for consideration in the regulatory approach is source characterization. A moderate degree of ambient impact monitoring should be performed in order to validate

predicted impacts and to document trends and changes from baseline. Programs to evaluate effects upon "receptors" should be performed in order to provide feedback on the source and ambient monitoring programs.

A final concept in the approach to regulations involves the concern over nonregulated pollutants such as trace elements. Although not regulated, some trace elements may not be released in a significant enough quantity to present environmental harm. Threshold Limit Values (TLVs) have been defined by OSHA for many inorganic and organic elements/compounds. A screening analysis could be performed on the potential amount of a "nonregulated" pollutant that might be released from an oil shale facility. If a significant--i.e., much higher than the TLV--concentration were predicted, source characterization, ambient monitoring, and effects programs could be implemented as applicable.

BACT for criteria air pollutants must be implemented for any proposed oil shale facility with the potential to emit 100 tons or more per year of any criteria pollutant. Those facilities that have potential emissions less than 100 tons do not need BACT but should be required to perform comprehensive monitoring. Two primary mechanisms exist to define BACT. First, several oil shale facilities have received PSD permits. BACT has been defined on a case-by-case basis for these facilities. Second, air pollution control technology, which has been defined as BACT for "oil shale related facilities," may be considered as transferable to the oil shale industry.

A no-discharge of pollutant concept is being considered by most oil shale developers as means of handling their waste water streams. A no-discharge of process water concept has been written into NPDES permits. If any water is discharged to a surface stream or reinjected into the groundwater system, it would consist of mine inflow (but not retort or backflood water) uncontaminated surface runoff. Treatment may or may not be necessary. BPT and BACT should be defined for certain pollutants for certain oil shale process streams. A few major factors to be addressed by regulatory agencies and the oil shale developer are summarized in the following sentences. First, because of the semiarid water-short condition of oil shale country, it may be "environmentally best" to encourage treatment and discharge to a surface stream of nonprocess water. Second, because of salinity considerations treatment of certain nonprocess streams and/or minimization of water consumption may be a desirable policy. Third, disposal of process water onto processed shale piles without treatment may not be desirable. The high organic and salt concentration of the process water may represent too great of a risk to groundwater/surface water quality because of potential catastrophic events or unexpected permeabilities/leaching. Fourth, maximum recycle/reuse of process and nonprocess water will be encouraged. Finally, land application of untreated nonprocess water may be desirable only for a short period of time due to the potential nonpoint source runoff problems.

Solid and hazardous waste should be disposed of in a manner that prevents its contact with water, which would result in toxic concentrations. Disposal practices should be designed that preclude (or at least minimize) the potential for the solid material from becoming airborne as a fugitive dust. Safe disposal practices as defined at 40 CFR 250 (pursuant to Sections 3002 and 3004 of RCRA) apply to oil shale facility hazardous wastes such as spent catalyst, API separator sludge, tank bottoms, cooling tower sludge, water treatment plant sludge, and perhaps processed shale. The principal solid waste from an oil shale industry is of course processed shale or raw shale. Surface disposal at a minimum should conform to those practices proposed at 40 CFR 257 pursuant to 4004 of RCRA. Special disposal practices for high-volume semihazardous waste materials, such as processed shale, may need to be defined under a special category under the RCRA regulations.

Suggestions for Interim EPA Emissions, Effluent and Solid Waste Disposal Standards

Standards Criteria and Environmental Goals

Section II of this paper describes existing legislative and regulatory constraints and Section III describes a regulatory approach to defining environmental standards that should be met by any oil shale facility and by an oil shale industry. The environmental goal applicable to an oil shale industry should be the "minimization" of environmental impacts. Minimization must be defined in terms of potential environmental harm, economics, energy penalty, and intermedia tradeoffs. A no significant degradation policy has been quantified for a few air pollutants (SO_2 and particulate) and has been qualitatively stated for water quality. Protection of minimum stream flows for aquatic life, provision of adequate water quality for applicable water use, protection of health and welfare related air quality aspects, minimization of detrimental land disturbance in order to preserve adequate wildlife habitat, and protection of valuable socioeconomic, cultural, historical, and aesthetic values are environmental criteria that constitute the basis for defining specific environmental standards.

Suggestions for Interim Regulatory Guidelines and Standards

The source standards and ambient standards discussed below could apply to individual oil shale facilities and to an oil shale industry. The ambient standards have the most direct impact on the industry (rather than any individual facility) in that the Piceance Basin and

the Uintah Basin (and Colorado River Basin) have a finite "carrying capacity" for air pollutants/water use. Although attempts have been made to define the size of an oil shale industry that could fit into this "carrying capacity," a paucity of data and comprehensive predictive efforts have limited the successful accomplishment of this task. Facility siting is an obvious major factor in determining the ultimate size of an oil shale industry.

In an attempt to both build upon previous details and to provide summary guidance on environmental requirements to be met by an oil shale facility and by an oil shale industry, suggested interim guidelines are provided below.

1. Air

Source guidelines (daily averages)

- 99.5% total sulfur recovery from retort off-gas streams or less than 50 ppm S at 0% O_2 stack gas concentration (dry basis)
- 0.8 pounds of SO_2 per million Btu for liquid fuel combustion sources
- 0.10 grains H_2S/dscf and/or 250 ppm SO_2 at 0% O_2 dry) for process fuel gas
- 0.3 pounds of SO_2 per million Btu for gaseous fuel combustion sources
- 0.5 pounds of NO_x per million Btu for liquid fuel combustion sources
- 0.2 pounds of NO_x per million Btu for gaseous fuel combustion sources
- 75 ppm NO_x at 15% O_2 for gas turbine combustion
- 0.03 pounds of particulate per million Btu for any fuel combustion source
- 99.8% particulate collection for any materials handling source
- 0.022 grains/dscf on all process streams
- 10% opacity for any particulate source
- 30 inchΔp wet scrubbers for particulate
- Fugitive dust control measures such as those described in the EPA Region VIII Interim Policy Paper on Air Quality/Mining
- A maximum concentration of 100 ppmw of uncombusted hydrocarbons from fuel combustion sources

Ambient Standards

- NAAQS
- PSD increments
- State ambient SO_2 standards
- 5 $\mu g/m^3$ (24-hour average) $SO_4^=$ concentration in Class I areas
- 5 $\mu g/m^3$ (24-hour average) NO_3 concentration in Class I areas
- No significant degradation of visibility in Class I areas
- Hg, As, Se, Cd, Be and Ba TLVs
- 37 $\mu g/m^3$ (24-hour average) fine particulate (2.5 micron) concentration in Class II areas and 10 $\mu g/m^3$ (24-hour average) in Class I areas

2. Water

Source Guidelines

- No discharge of process water
- Treatment or dilution of discharges to the following:

TDS	723 mg/ℓ (weekly maximum) and 1 ton per day of salt	
F	3.0 mg/ℓ (daily maximum)	
B	5.0 mg/ℓ (daily maximum)	
TSS	30 mg/ℓ (30 day average) 45 mg/ℓ (7 day average)	
NH_4^+	1.3 mg/ℓ (daily maximum)	
Phenol	0.2 mg/ℓ	"
Al	1.1 mg/ℓ	"
Fe	7.0 mg/ℓ	"

- Other metals limits compatible with designated stream use
- Removal of organics and $SO_4^=$ from prior to disposal on solid waste pile
- Diversion of runoff from process areas
- Collection and containment in lined evaporation sedimentation ponds of all process area and disturbed area runoff
- Maximum recycle and reuse of water
- Collection and containment (no discharge to surface water or ground water) of process shale pile and/or runoff

Ambient Standards

- State water quality standards
- Colorado 208 standards
- 723 mg/ℓ TDS in the Colorado River Basin
- Prevention of groundwater contact with spent in situ retorts unless retorted shale is impermeable
- Up-drainage and down-drainage from processed shale pile collection/ evaporation ponds

3. Solid and Hazardous Wastes

Source Guidelines

- Isolation and containment of hazardous wastes such as spent catalysts and process sludges
- Compaction of bottom, top and edges of processed shale pile into an impermeable mass
- Disposal of processed shale in areas other than the 100 year flood plain, wetlands, critical wildlife habitat, and recharge areas to sole source aquifers

Ambient Standards

- Prevention of contact of solid and hazardous wastes with water (which leachate would subsequently be discharged) whose concentration would exceed 10 times the drinking water standards
- Prevention of (or minimization of) solid waste/hazardous waste materials becoming airborne as fugitive dust emissions
- Contouring solid waste materials to provide harmony with the surrounding landscape.

Issues

I would next like to address several issues that have either been consistently discussed or have been raised in the past by the oil shale industry.

First, the number of permits required for a facility is consistently raised as a constraint. EPA is investigating opportunities for permit consolidation, but I must ask the obvious question--How many of these permits are environmentally related? Second, the high background air quality levels of articulate, hydrocarbon, and ozone have been considered and discussed at length. EPA has responded in the form of development of a rural fugitive dust policy, consideration of revocation of the hydrocarbon standard, the drafting of a proposed rural ozone policy and proposed revision of the ozone standard. Third, it has been argued that the inclusion of fugitive dust from oil shale activities is not consistent with the intent of PSD. The promulgated PSD regulations will not require consideration of fugitive dust (i.e. non-oil shale material) emissions in evaluating compliance with PSD increments. Fourth, concern has been raised over the level of soon-to-be proposed NSPS for electric utility facilities combusting oil shale derived products. It must be made perfectly clear that these standards will apply only to those facilities that sell more than one-third of their produced electricity and have a unit capacity of greater than 250 million BTU per hour. The proposed standards limit SO_2 emissions to 0.2 to 1.2 pounds per million BTU coupled with an 85% reduction. An 80% reduction was proposed for use of synthetic fuels. The particulate limit is set at 0.03 pounds per million BTU coupled with a 99% reduction. However, the percent reduction does not apply to liquid or gaseous fuels. The NO_x limit for synthetic oils or gas is proposed at 0.5 pounds per million BTU. Conventional oil and gas limits are 0.3 and 0.2 respectively. Emission rates may be averaged over a twenty-four hour period.

A fifth issue involved RCRA. As previously mentioned, critieria defining hazardous wastes and performance standards establishing safe disposal practices were proposed in December 1978. As proposed, processed shale, if considered hazardous via the toxicity test, will be subject to the full range of proposed standards. A sixth issue involves the PSD Class I/Class II designations. The development of a well controlled, environmentally sound facility should be able to exist within the constraints of a Class II designation. If Class III is needed it should not be needed until the oil shale industry becomes very mature.

Finally, uncertainties in the regulatory framework have been discussed. I would acknowledge that there are instances to support these statements. However, I must also acknowledge that there have been several instances of uncertainties on the part of the industry. Instances including uncertain emissions data, control devices, control device efficiency, water discharge rates, water effluent composition coupled with changing plans and missed reporting dates have not left the industry with a clean slate. It behooves industry, government, and the public to avoid surprises. Communicating the best information available can serve to minimize the number of surprises.

Conclusion

Some oil shale developers have tended to become frustrated by the lack of definition of clear, concise environmental requirements that they must meet. This situation has arisen in

part because of relatively recent environmental legislation passed by Congress and because of the cyclic go/no posture of the oil shale industry. In order to provide regulatory guidance to the industry, EPA is working on a "Position Paper" that will provide guidance on the long-term requirements that the industry must meet. This document should be ready for review by May 1979.

Because of the nation's need for domestic petroleum sources and because of the environmental and technological answers to be obtained regarding oil shale development, EPA supports the limited development of oil shale. Judgments may then be made on the size of an oil shale industry that may be developed. Regarding prototype development, EPA's philosophy is do it but do it environmentally right.

Question: Regarding ozone standards, do you have an idea of whether the secondary level will be retained?

Answer: Most likely not. It may go to .1 or .12, not any higher.

Question: How does the developer get a certain amount of certainty that once he gets a permit for that facility, some years down the line he is not going to be subjected to some new and more stringent requirements?

Answer: There is not a lot of flexibility. I do not think we can guarantee that certainty. A few instances we can--the air quality permit, a PSD permit is issued for the life of that project. Where we cannot give certainty is in solid and hazardous wastes and water discharge permits. Water discharge permits mandated in the Clean Water Act states it has to be reviewed every five years.

Question: How do you change regulations?

Answer: When EPA issues, for example, an air quality permit we establish the best available control technology--what the limits are--we have to consider the costs and arrive at what is an economically and environmentally reasonable standard. If because of the uncertainty of the emissions data, and obviously there is a lot of uncertainty in that area, we do not know exactly what the emissions are going to be, if you get the plant up and running and you find out that the emissions that are going into that control device are much different than those you had told us in your PSD application, and if you are meeting the control efficiency that we also established--it is a simple matter of adjustment of the permit condition. I do not see that as any major problem. If we project down the road that the oil shale industry, after you get a lot of facilities, that the ambient concentrations are higher than once was expected, the state has a responsibility to go back and change the emissions standards.

Question: (Frank Berryman, Chevron) Can you comment on whether there will be a need to maintain visibility from Class I areas, that is outside of the area but can be seen from the area as opposed in inside it.

Answer: We do not know yet.

Question: (Berryman, Chevron) In regard to the Fire Service published findings, have you had an opportunity to determine if the act creates any new wilderness areas near to shale country in the Piceance Basin, the problem being they could become Class I areas in the future.

Answer: I have not specifically looked at that. I heard that some of the areas being considered were near oil shale country. One of the proposals was more of the White River National Forest which would in effect move the Flat Tops Wilderness are closer to oil shale country. But if they are classified as a wilderness area, there is a process that a land-manager can recommend to Congress and/or the state to then designate it as a Class I area.

Question: (Rees Madsen, White River) Will individual process shale be considered or will process shale as a category be lumped in as a hazardous waste?

Answer: They will be looked at on a process by process basis. There was a list of compounds that were automatically designated as hazardous. Processed shale was not on that list. Rather the toxicity test will be applied to each process. This will lead to a situation whereby one type of processed shale may be indicated as hazardous waste and another type nonhazardous.

Comment: (Mark Mercer, EPA) If you look at individual waste streams within a facility may all of them be then categorized as hazardous or nonhazardous?

Comment: One of the key things is that we need to look at some data from processed shale under those disposal type conditions. This data is not available at the present time, to my knowledge.

Question: (Madsen, White River) Does this mean that, for example, Colorado processed shale disposal system might be considered hazardous whereas if data was different in Utah, that processed shale system would be classified as nonhazardous?

Answer: Yes, that situation could exist. Processed shale, regardless of the type of process used, may have different characteristics and different things may be done in the disposal scheme. For instance, someone may be putting a certain type of waste with that processed shale, so the final waste product depends on the inherent characteristics of the processed shale as well as the disposal techniques.

Harry McCarthy of SAI was introduced and asked to comment on their DOE-sponsored project on analyzing the permitting process.

SCIENCE APPLICATION, INC.,
HARRY MCCARTHY, VICE PRESIDENT

About seven months ago, at a meeting held in Denver, the permitting maze was pictured as a real problem in oil shale development. Jackson Gouraud indicated that maybe this would be something that DOE could help solve. If a permitting road map were built, one which could be updated as necessary, both the regulatory agencies and the oil shale developers would benefit. In order to make this road map useful, it must be current--which leads to the problem of changing regulations. Therefore, we have a two-phase program. Phase I was designed to find out whether there was a definable system suitable for automation. We examined the enabling legislation, went into the field to collect existing permits, and made cross checks between enabling legislation and the existing permit system. We made correlations from top to bottom to try and make sure that we had a comprehensive set. We looked at federal, state, and county regulations and permits. We did include the municipal level with its emphasis on zoning. We found that a trackable system exists, but it is a constantly changing system.

We have finished the first part, which defines, as of June 1978, a manual flow system. Given a technology and county location, the manual system enables us to draw a flow sheet of what the permitting process looks like. We were not able to do that very easily. We had a lot of help from the oil companies, particularly C-a and Colony Development. They showed us what they had been required to do, and this gave us a good basis. We went through some of the EPA's offices and were able to compile a lot of data. With help from many agencies, we came up with something comprehensive. Those of you who want a copy of the first phase report can request one through Andy Decora's office at LETC.

We have now started on Phase II, which is to automate and validate the system. We have an interim funding arrangement now with DOE to fund us for a couple of months. We are looking forward within about twelve to fifteen months to having a computerized road map that will be updated. We have had great cooperation with all three states. These permits are only for oil shale and only for Colorado, Wyoming, and Utah. Colorado is interested in pursuing this in their joint review process to try and streamline their permitting process. I think the biggest output one can get, once we have this system, is an indication of how the system can be streamlined to eliminate redundancies and get to the most stringent requirements. I believe the states and EPA want to eliminate this overlapping and understand the overall process. The system being developed will help us all by providing them a tool to help streamline the process--that is our goal.

Question: (Ron Bissinger, Union Oil) If we are going to do this for oil shale, will the permits be any different for coal, coal gasification, and so on--should it include all of those?

Answer: Yes. Some permits apply to most energy sources. We are not sure of the interactions as a proposed ongoing program. DOE's feeling is that it is a good idea and should be done, but they want to do it for oil shale and make sure that it is functioning before we spend money on all the other energy resources.

Question: How long does it take to complete the permitting cycle?

Comment: The time is dependent upon a number of things. The location and the type of process all vary. What we are doing in this program is to give estimated time; we have not included the time that you might have to recycle.

Question: It is in the form of a critical path?

Answer: (Harry McCarthy, Science Application, Inc.) Yes, for each type and location of development we present a path with the critical factors noted. It is not the only path that you

could go through. There are alternate paths, but you do have certain criteria that you have to meet at certain places. We have picked what we consider a logical path.

Question: (Ken Olson, Gulf Mineral Resources) There are permits that are given that have time frames as part of the requirements, there are others which do not. Do we point that out?

Answer: Yes, we do. We point out where it is known. In the ones where there is no legislated time frame, we try to rely on an experience factor, which is often lacking in the case of oil shale. If other estimating factors are lacking, we solicit estimates from the cognizant agencies.

HANK COFFER, PROGRAM COORDINATOR, C.K. GEOENERGY CORP.

I would like to review a report we made for EPA late last year when we contacted all the major companies involved in oil shale to see just what you thought about the critical constraints. We went through air, water, waste disposal, and we found that when we asked you to list high priority and low priority items, we found that by and large the majority thought that the sulfur oxides, the nitrous oxides, the hydrocarbons, and the groundwater control were major priority problems, and that the disposal and process water and surface water releases were minor problems. We talked to the six companies that we felt at that time were most active in oil shale. They felt that the problems that the majority said were critical were not really critical. But when you got down to the bottom line, it turned out that there were very few, if any, problems that those who were working close to oil shale felt were critical. I think we find ourselves in a situation where the environmental issue has become a whipping boy that industry and government can hide behind--we cannot move fast because of environmental issues. But when you look at it, it looks as if environmental issues can be handled. Environment may not be the major issue at all. It may be economics.

Dr. Coffer asked the various company representatives for any comments on these issues.

Comment: (Harry Pforzheimer, Sohio) If in fact we do not see any big serious accidents down the road in the module program, and we know that we have to have the module program going to get the kind of data we need to actually implement the regulations, then my proposal was why do we not just go forward with some sort of exemption of the type that was granted for the Alaskan pipeline so that people can do their thing and can be monitored by all government agencies to get the necessary information and then determine what the problems are with respect to going commerical. I did not want to leave the impression that there was no red tape problem. We have not actually gotten into it, but a lot of other people have gotten into it.

Comment: (Hank Coffer, C.K. GeoEnergy) I did not mean there were no problems, but they seem to be solvable problems.

Comment: (Pforzheimer, Sohio) One way to solve them is to grant an exemption to start out with--get the data and see what problems we have got to solve. I am not saying that this can be done, but think about it.

Comment: (Blaine Miller, C-a) Obviously there are some problems that I believe I agree with you are solvable. One thing I do question is that I think some of these problems develop at different times with different projects, and that it may be very difficult to have an industry/EPA solution to these things. Our communication with EPA has been excellent, and I hope that it will remain that way in the future.

Comment: (Coffer, C.K. GeoEnergy) Someone from EPA has stated that after getting acquainted with some of you they would like to open the lines of communications with you on a one-to-one basis.

Comment: (Alden Christianson, EPA) We would like to try to work on a one-on-one and not with EPA with a collective industry single voice. There are problems with each company, they have specific problems all are interested in approaching, studying, trying to resolve these problems.

If individual companies have situations to address to EPA we could probably coordinate and cooperate with them. We would like to have those kinds to situations brought to our attentions so we could try talking in a one-to-one manner. It is impossible to work one to twenty-five all the time. Please contact one of the following:

Alden Christianson, Terry Thoem, or Gene Harris, chairman of Oil Shale Work Group.

Comment: (Bob Thomason, C-b) I think that a certain amount of one-on-one effort is indeed necessary and should continue. With all of us together with such a broad collection of disciplines and interagency communication opportunity it should be carried one step farther. There is no one in this room who does not think that an oil shale industry is a

desirable thing. We also agree, I believe, that an effort towards development of the sizable shale oil producing industry is of benefit to our national needs. I think a common sense of urgency and a commitment to meet this objective on industry interagency basis and industry effort is something that is really needed. With regard to constraints, we find that working on an individual project basis there is some lack of communication between the EPA and the state agencies. I do not think it is the EPA's fault, but there is a huge gray area in the interpretative part of these regulations. When it gets filtered down to the technical people who actually set the criteria, the permit criteria often becomes very restrictive. We absolutely have to get started in this particular train of events of how we get from here to there. We want to commence the commercial-sized demonstration and confirmation of actual operating conditions to develop the data that is necessary to serve as a basis for reasonable regulations. This really is not happening right now. It has to happen before we can get to that sizable industry that is going to make an impact on our country's energy needs. Initially the projects have to have a policy or the permits that effect those projects from a starting point have to have a policy of flexibility. The needs of an initially commencing project are different than the needs and requirements for a project at its production rate. We must have some sort of a timely process to get at the issuance of these permits that takes into consideration the flexibility that is necessary.

We do not have a timely process. There is an inconsistency in the way the different regulating agencies do their thing. We have one agency that does have time limits on the issuance of permits. They have got to act in a timely fashion. We have another agency who apparently has no time limits on the way they respond to permit applications. As an example, we have had an application for a National Pollution Discharge Elimination permit for tract C-b for now eighteen months now. The criteria for that particular permit has changed numerous times during its development. The longer it takes, the more changes are involved in it. We cannot live with that kind of due process. We have to have some elements of flexibility and timely operating conditions in the issuance of permits. Some of the other areas that interagency effort could be of benefit, and they have economic impact, is in the modeling. Air quality, we think, is a manageable thing. We have the experience and capability of controlling pollution from emitting sources, yet there is a lack of the appropriate realistic models for predicting the impacts from those emissions in the basin. We need a very good rough terrain model. It is critical to the development of the industry. The location of the emitting sources can have a huge economic impact and on the quality of air. There needs to be some sort of an integrated approach in this direction. Similarly in the area of water, and there is a basin-wide profit for modeling the effects on the groundwater and surface water from the standpoint of completions. I think that is a beneficial effort and should continue on an industry interagency basis. That model, once refined, will probably serve as a tool to define just what is going on.

In the area of water quality, again the classification of the streams in the state is a critical issue. Something is lost in the way of communication between EPA and state agencies. The permits are being formed on the basis of the stream being classified as a fishing stream or they are not. This criteria should be developed on the basis of historic and practical use. A concerted effort needs to be brought to bear to the proper classification of the Piceance Creek. It is critical to this developing industry.

Certainly we perceive our individual efforts on a one-on-one basis with the various regulating agencies, but wny not have an interagency industry task force to consider these main issues and something we can develop clout with? We get together and talk about all these things--but we do not develop anything that has clout. We have to do that in order to be a successful industry.

Comment: (Rees Madsen, White River) In regard to solving problems, we all realize that as we get closer to processes we find problems and of course our job is to solve those problems. We have to recognize that

if the regulations and legislation that are passed contain these kinds of fatal flaws that we are able as industry and regulatory people to recognize those as things that could be stumbling blocks. One of the things we need is additional data and one of the ways to do that is to build a facility that is going to operate under normal conditions. In that regard, when we go in for permits and so on we are using condition factors that have been borrowed, a lot of times from other industries, which may or may not be applicable. We are using emission factors that have been developed from data that may not be true operating data but is more test data developed as a spin off of some other work and this is another reason that has been mentioned for full-sized demonstration. Full-scale modeling work is critical. Models are going to be the thing that will decide whether you will need to get a permit. Models are something that industry is not completely equipped to do work on. It is going to require the input and expertise of EPA, DOE, and others.

In regard to new regulations, I am always interested in talking to people who have researched the program to come up with the numbers that are submitted to the regulatory people to decide on the regulation number, like 160 micrograms per cubic meter. Often times the research individuals do not have a lot of input into the final number that is developed for the regulation. We find ourselves inclined to detect a ceiling with instrumentation that might only be able to measure plus or minus 20%. In the case of hydrocarbons it might be able to read plus or minus the standard value. It is of concern to industry and myself in particular that maybe this kind of evaluation of research results is not being completely incorporated into the numbers that are developed in regulations. We deal with legislations and regulations, but we also deal with interpretation and administrative decisions. This latter group is a little bit risky, in my opinion, to be basing a 1.5 million or $1 billion facility on, and some of these things should be put into a firm regulation. They should not be administrative type regulations but should be made more formal so that the risk of lawsuits are at least somewhat more minimized than they are at the present time.

Comment: (Coffer, C.K. GeoEnergy Corp.) I do not think EPA has any intent to proceed on their own at all. They want to continue cooperating with industry, and they really like the interchange of information. Their timing is such that they feel the guideline document can be presented in rough draft to each participant before the next meeting. You can set up separate task groups to look at different parts of it, and then get the committee back as a whole and talk about it.

Comment: (Charlie Sullivan, Superior) I would like to group the problems we see into three categories: 1) Timing--time to industry is money, and anything that can shorten up the timing would be greatly helpful; 2) Ways to reduce the risks on the changing baselines on the permits, and 3) The suggestion that if we are interested in regulating the oil shale industry, we at least ought to know what that industry is. The programs under way now are strictly limited to the Mahogany Zone and in situ leasing processes. The whole spectrum of processes should be looked at so that we know what is the best process for the country for the production, not just how well one process will work.

Comment: (Paul Dougan, Equity Oil) Environmental problems are minimal with the fully in situ process.

Comment: (John Maziuk, Mobil) We have not been very active in a project but have been interested in the progress of them. One thing I have seen here is the intent of EPA to work closely with industry in setting up these standards and the one-on-one approach. This should be implemented, and I am sure anything we can do to help, we would be happy to do so. But we still have not had that direct interest that is shown by the other participants.

EUGENE HARRIS, EPA,
CHIEF, EXTRACTION TECHNOLOGY BRANCH,
GUIDANCE DOCUMENT COMMENT

This is a document to set up some kind of goals for the EPA. What we are putting together now is what EPA has learned from you from the many times you have told us what your intentions are and the people that have been kind enough to have our group on their sites to show us what is happening. In this document is what we understand is happening.

It is written by EPA people mostly. We have had some contractor help on things that we did not know about. By February we should have the first write up. And it is very preliminary. There will be people in my group reviewing it and getting other opinions on it. As soon as we get the document in one piece, we will send it to the program offices.

We do have on our committee representatives of the program office who are involved in many things and cannot make the meetings too often so their contact with the industry is limited. Usually the people who come to our meetings are coming to keep their groups informed on what is happening. They are not making policy at the meetings, just keeping informed. When we get a document together we send it to the program offices, so they can look at what the individual researchers understand the situation to be and what his projections are as to needs. If they have problems with it, (and the problems they may have are what we have projected as research needs or timing will not fit the requirements that have to be met by law) they may come back and ask to have it revised. We do not anticipate any regulations for the oil shale industry until into the 1980s. The people I am talking to who write regulations are just beginning to learn the word oil shale.

This document will help see how our research will fit into their plans. The role of our group is to furnish data so that when a regulation comes out it is something that is reasonable, something that the regulatory people can really enforce. We would like to reiterate to the program officers on what we think is a meaningful regulation and give them the data to back it up. When we get their response back and their comments we will incorporate that into the draft.

That is the version that we would like to give to you. We thought that would be the document that you would prefer to see. That has the program offices and the regulatory people's viewpoint incorporated into it, which means something to you. We need to give the regulatory people good sound information as much as we can. This document is to put together all our guesses, and we want you to look at it before we publish it. We want you to tell us whether we are missing it a mile, whether we are close enough that it will not hurt anyone, or whether it is going to be useful. If you can tell us how to make it useful, we would be tickled to death. We would like to have at least a place to start and are hoping that you will help us. If you do, I think it will mean something; if you do not, it will be another federal document that you can throw on your shelf.

If there is some opinion that it is the wrong time to give it to you, there are other reasons for holding it up. First, if we gave it to you now, we would be violating rules. When one individual has written a document, he is not allowed to release it until it is reviewed by at least his supervisor and in some cases even higher than that. The office involved is to have some say as to when this is released. We just could not give it to you until at least one review. Beyond that point, we would be happy to entertain changes.

Comment: (Hank Coffer, C.K. GeoEnergy Corp.) Probably we are using the environment as a whipping boy. We do need clout so that we can stand up and say we do not really have to wait for the environmental issues to get out of our way--they can probably be handled. The other thing that has not been spoken to is the research program that EPA is conducting. They would like to make that as joint as possible. So if you have any ideas that you would like to see tried, they have funds and they would like to do things in conjunction with you. Secondly, as we look at the guideline document, we will probably set up the typical task force to look at various parts of the document and then after these groups have looked at it, come back at a general meeting and discuss the whole document. It will probably split out by air, water, and solids basically. A meeting will most likely be held in July. If anyone feels that this task force should start any earlier than that, then we would entertain looking at an earlier meeting. We will not have the document to work with until about July. Our current plans are to get them to you individually. The task force will probably be voluntary with companies who would like to serve on the various portions, air, water, or solid. We will also make efforts to integrate into these the BLM and the state people so that we have full coverage.

Question: If there will be no document till July are you not going to miss an opportunity to get some input into the March hearings aimed at regulatory revisions? I understand that their hearings are in March. Is this group going to have some sort of joint effort addressing itself to the problems of solid disposal--should it not occur a little sooner and perhaps get that input into the record?

Comment: (Terry Thoem, EPA) The meetings will be held March 7, 8 and 9 in Denver. The critical document is

the December 18, 1978, Federal Register. Those of you who have not seen that, look at it. We have solicited your opinions and thoughts on it. We need to get the companies to look at the impact of those regulations and get your input and comments on that. How we collectively can influence that I am not sure. One way is for the EPA oil shale work group to make sure that they look at comments that come in regarding those regulations.

Comment: (Coffer, C.K. GeoEnergy Corp.) With those coming up in March, it is probably pretty tough to get a group together. The best interaction forum is the direct approach of each company that is going to be impacted by the regulations to get with EPA.

We will be meeting with EPA on how to implement these task forces in the three areas and will be back in contact with you. Those meetings probably will be held just before the general meeting, to discuss the guidance document.

Hank Coffer adjourned the meeting at 11:30 a.m.

ATTENDEES OF THE FIRST MEETING OF JOINT EPA/INDUSTRY
OIL SHALE WORKING GROUP

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